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# Process Improvement for Software Localization

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## PREFACE

I do not consider this study another academic paper, but rather one of my most interesting and challenging projects. Completing his work, helped me develop practical knowledge that I implement in my daily work. It was quite difficult to perform this task, especially while working remotely in Germany.

I would like to give thanks to my team in Berlin, especially to my line manager, for allowing me to use part of my working hours for developing this Thesis. I also want to thank my colleagues for all the support and great ideas they contributed.

I would like to give sincere thanks to my professors: Marjatta Huhta and Thomas Rohweder for all the support they gave to me, especially while I was away from Helsinki.

I want to say that this Thesis would never be possible to accomplish without the full support of my wife Veronika Gonçalves who patiently supported me through all stages of this work.

I am happy to say that this work was well received among several teams at my work place. Soon I will leave the localization team to be responsible for Quality Assurance and Project Management in another unit of the company. This position appeared because the team was in need of someone with a strong background in Quality Assurance, Project Management and process improvement; a background I developed while working on this study.

Berlin, April 23, 2011

Luis Gonçalves

**Abstract**

Degree	Master's degree
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Instructors	Thomas Rohweder, DSc (Econ)/Principal Lecturer Marjatta Huhta, DSc (Tech)
<p>Competition in mobile industry is tougher than ever, forcing mobile manufacturers to fight for their market share. In this challenging environment, companies must release new software at a high pace and frequency.</p> <p>The overall purpose of this Thesis was to create a basis for a process improvement framework in localization teams. This study is specific to the case company, but the outcome can be applied to other localization teams, especially for those that work in an Agile Mode, and especially those using SCRUM.</p> <p>This study focuses on the process improvement for software localization inside of the case company team. It is crucial to have three weeks' time to be fully aligned with the application engineering team, and there are parts of the process that need to be changed in order to improve the current process. These aspects were analysed in the study, and we came up with possible alterations to the internal operation and correction methods, allowing for reduction in cost and time.</p> <p>In order to have accurate results, we analysed different methodologies of process improvement such as Six Sigma and Lean methodologies, always aligning the outcome with the Scrum methodology, which our entire company uses. Several internal teams contributed to this exercise, adding important feedback to this study.</p>	
Key words	Localization, Scrum, Six Sigma, Process Improvement, Lean

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## **LIST OF ACRONYMS**

UI – User Interface

JIT – Just in Time

PDCA – Plan, Define, Control, Act

ROI – Return of Investment

SSD – Six Sigma Design

DFSS – Design for Six Sigma

DMAIC – Define, Measure, Analyse, Improve, Control

CTQ – Critical to Quality

SIPOC – Suppliers, Inputs, Process, Output, Customers

VOC – Voice of the Customer

## **GLOSSARY**

Build: A software package ready to be installed into a mobile phone.

Stable build: A pre-tested software package ready to be installed into a mobile phone.

Emulator: A software tool that emulates a real mobile phone.

Piece of software localized: A localized part of the software.

Bug: A software error.

Bug fixing: An error correction phase of the software cycle.

String: A group of words displayed on the mobile phone.



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## 1 Introduction

The main objective of this Thesis is improving process improvement in software localization. "The biggest mistake is for people to think that localization is just taking a product and translating it" (Kubo 2005:2). *Software localization* is the process of adapting software to a certain culture and language. Localization is, in fact, more than that. There are many other details to be taken into account, such as date format, currency, address format, colours, graphics, and others. Colours and graphics, for example, may become quite important because different end-users associate different meaning with different colours: in western countries red symbolizes alarm, white purity, and black sombreness. In Asian cultures, red signifies joy, white mourning, and black luck (Collins 2001). Successful localization projects should take all these issues into consideration.

When a product is created to be and sold in other countries, all localization activities must be considered beforehand. (Downey 2004). This is why the first step for effective localization is internationalization.

Percy (2010) defines internationalization as the process of creating software that can be easily adapted to the needs of users in other countries. Localizing a piece of software that was not internationalized can be difficult. For example, Arabic and Hebrew languages are different than Western languages; these languages are called "right to left" languages. The reader reads from *right to left* instead of *left to right*, as in Western languages. From a software implementation point of view, this must be addressed beforehand by adjusting the software architecture. Another example is the relative size of characters in different languages; the Japanese or Hindi characters; Western characters use one byte of memory per character, Japanese or Hindi characters use two bytes of memory per character. These are small but vital differences which illustrate how important it is to plan localization from the very beginning of software development.

Internationalization should therefore be part of the initial product architecture. The engineering team should work in closely with the localization team to adapt the product to other countries. If internationalization is integrated into the structure, it will define design and construction of the product. (Kuba 2005)

The topic of this Thesis has come up from the need for an improvement in the localization process in the case company. This has become a unique opportunity to apply action research to find solutions to an important business problem.

### 1.1 Case Company Background and Business Problem

The case company is a big player in mobile industry, delivering phones to five continents. The company heavily prioritizes localization in its product development. Localization helps the company remain a global player, and it is important to improve its localization process and align it with the engineering development teams.

Presently, localization is a crucial part of the case company software development process. The case company supports dozens of different languages in various software development platforms. At the moment, the company is now moving away from the traditional Waterfall model to a more agile software development method. Now, Scrum is widely used in the company, and will impact the localization process.

Presently, the case company does not have a dedicated team of translators/localization testers, so localization is outsourced. After any change to the localisation process, the external vendors must adapt. After such changes, it is expected that some new errors may occur; therefore, a new process must be developed streamlined and corrected.

The Maps Localization team of the case company is responsible for the whole localization process, as well as for the vendor and budget management. The team is also responsible for transforming the localization process into a three-week cycle, which is aligned with the three-week engineering cycle of development. The starting point of this Thesis is the management request for a new process. This Thesis analyses the localization process and identifies a possible process improvement framework for software localization.

At present, the current localization process takes five weeks to complete. But the engineering team usually needs only three weeks to complete a full cycle of software development. Therefore, the business problem of this study is that *the new, improved localization process cycle needs to be reduced to a three-week period*, which will synchronize it with the software development period, *while keeping the number of errors to a minimum*.

## 1.2 Research Objectives and Research Question

The objectives of this study are, first, to create a possible framework for process improvement in software localization; and second, to apply this framework to the case company.

Since the reduction of time and errors in the current localization process poses a significant challenge, this study seeks to find possible improvements to the existing localization practice, taking into account these time and error reduction considerations. The goal is to create a new framework with the three-week localization period, with a pass rate of higher than 98%. This pass rate is the usual pass rate for software released by the case company, and the new process needs to adhere to the same standards.

The research question is:

*How the localization process for software localization can be improved, in order to reduce the time to a 3-week period, while keeping the number of errors to a minimum?*

To answer this question, it is important, to understand the existing localization process.

## 1.3 Research Approach

The analysis method used herein to improve localization is action research. This type of research is often described as a cycle of “constructing” a problem statement, planning and taking the correspondent action, and finally evaluating the action (Coghlan et al. 2009:8). Sometimes, it is necessary to execute the cycle several times, until the expected output is achieved. This Thesis focuses on the “Constructing”, “Planning Action” and “Taking Action” phases but the team is planning to continue with improvements in the future.

The “Constructing” phase addresses fitting the localization process into a three week period, while maintaining a pass rate higher than 98%. The “Planning” phase explores a possible framework for process improvement for software localization. The “Taking Action” phase applies the theoretical framework to the research problem.

### 1.3.1 Action Research

Action research may be defined as an emergent inquiry process in which behavioural science is integrated into existing organizational knowledge and applied organizational problem solving. It is simultaneously concerned with changing organizations by developing self-sufficiency in organizational members, and adding to scientific knowledge. It is also an evolving process that is undertaken in a spirit of collaboration and co-inquiry (Coghlan, D. et al. (2009:4).

There is a big difference between action research and traditional research. In action research, there is a collaborative and democratic relationship between the members that participate in the study in order to obtain the best output. In traditional research, members are typically subjects or objects of study.

Another typical characteristic of action research is that Action Research occurs concurrently with action. While research is performed, the researcher simultaneously solves problems.

### 1.3.2 Action Research Stages

In action research, the performance framework includes a sequence of events presenting a possible solution as a final result. This is achieved in sequential interactive cycles consisting of data gathering and feeding the collected information into new cycles of research. Action research is an approach to problem solving because it is a scientific method of fact-finding and experimentation. This tool also fosters the collaboration of the action researchers and members of the organization.

To participate in an action research project, the researcher needs to be aware of the action research cycles. These cycles can be observed in Figure 1.

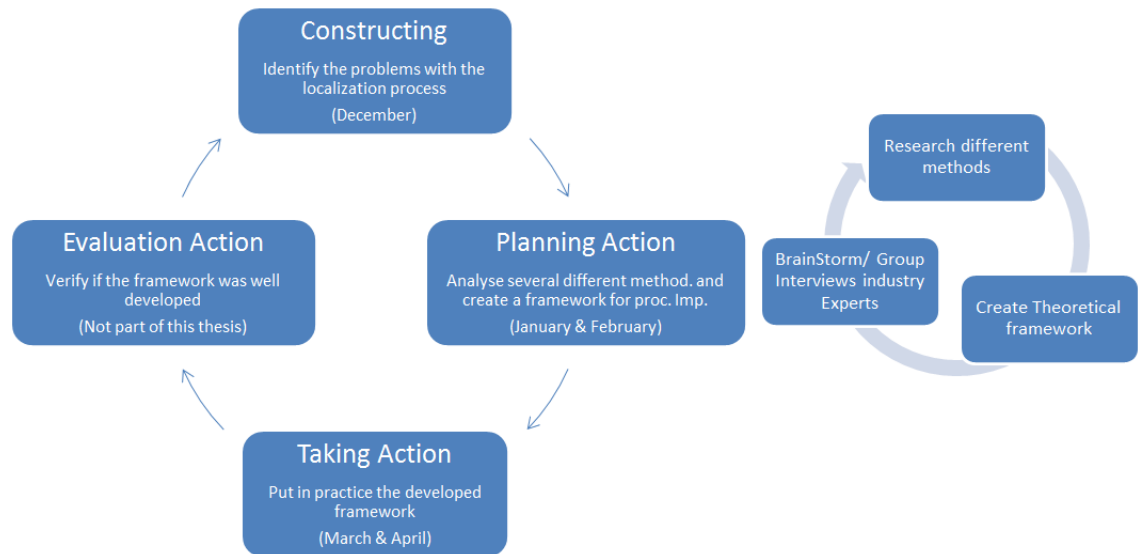


Figure 1. Action Research cycles, Adapted from Coghlan et al. (2009:8).

### Context and Purpose

Every action research project starts with a context and a purpose. Here, the project begins with the researcher asking why this project is necessary or interesting. The management team challenged the Maps team to improve the localization process in the case company. This is a perfect example of an action research exercise. Changing the current localization process is not a trivial task. There are a lot of different teams and organizations involved but since the outcome of this study is positive, the team had energy to improve company projects further.

### Constructing

Here, the researcher receives the requirements from his organization. In the context of this Thesis, all the necessary specifications were received from the management. The team recognised what was wrong with the process, identified the current problems and considered possible solutions. The constructing phase was performed in December of 2010.

### Planning Action

After collecting all requirements and identifying the problems, the team planned improvements for the process. Since the case company is using agile development (Scrum Methodologies) the best way to perform this planning phase was to start with literature review, studying a range of books and articles related to agile development and process improvement (Lean manufacturing and Six Sigma). The different methodologies were collected into a unique approach. Internal and external colleagues developed this approach in several brainstorming sessions which took place in January and February, 2011.

### Taking Action

The team succeeded in identifying the right approach to the action research problem. After reading selected books and articles, we formed a problem-solving framework. At this stage, the framework was put into practice during March and April of 2011.

### Evaluating Action

This phase verified if the original construction fit. The outcome of this phase will contribute to a new cycle of action research. This phase lies beyond the scope of this Thesis, and is not included.

#### 1.3.3 Data Collection and Analysis Methods

To collect objective information for this Thesis, several different models of process improvement were analysed, including Six Sigma, and Scrum. Possibilities for implementation were identified through group interviews with industry specialists and brainstorming sessions with team members. The internal localization team discussed all findings. All data used in the Six Sigma methodology was already available in the company. This data contains various testing reports from previous localization testing rounds.



Members of the local team analysed all suggestions for inclusiveness and logic. The table 1 resumes these activities.

Table 1. Material Data.

	<b>Type of Activity</b>	<b>Dates</b>	<b>N. of participants</b>	<b>Outcome</b>
<b>1</b>	Group interview with internal localization team	7.03.2010 10:00 – 12:00	Four	Answers to the survey
<b>2</b>	Interview Teleconference – Boston Team	8.03.2010 18:00 – 20:00	Four	Answers to the survey
<b>6</b>	Brainstorming session with internal localization team	14.03.2010 10:00 – 12:00  18.03.2010 14:00 – 16:00  23.03.2010 13:00 – 15:00  25.04.2010 9:00 – 11:00	Four	Outcome for different stages of the study (Six Sigma Study).

As previously stated, telephone and personal interviews comprise almost all collected information. The table 2 shows a resume of the most important information collected during these activities.

Table 2. Collected information in different meetings and teleconferences.

	<b>Resume of the collected information during the activities</b>
<b>1</b>	The local team answered group survey questions
<b>2</b>	The Boston team answered group survey questions
<b>3</b>	The team analysed problems and gave possible solutions. All this data is on section 4.

Test reports can be seen on the Appendix section. These reports contain all the testing information used in this Thesis in order to identify possible problems with the process. Meetings and brainstorming sessions were facilitated by the internal localization manager.

Group interview questions are found in Table 3.

Table 3. Group Interview Questions.

Questions to the Group Interview
1) What is the average length of the localization process?
2) What is the maximum time the localization process can take?
3) How long was the longest localization period? Why?
4) Which was the shortest? Why?
5) What is the minimum time necessary to have something ready for testing?
6) Based on your experience, what could be done to reduce the time problem?
7) Who struggled with communication?
8) Do you think that having more frequent meetings would help?
9) How do you think that other teams know about localization process and ways of working?
10) How could awareness of localization be increased?
11) How is the communication within the team?
12) Based on your experience, what could be done to improve the communication problem?
13) Do you know what is causing errors in overall localization process?
14) Do you know which part of the process has more errors?
15) Which part of the process would be easier to improve?
16) Which part of the process would be more difficult to improve?
17) What are the requirements of the new solution? (Financial, Not much change of common work, etc)?

#### 1.3.4 Reliability and Validity

Like in any other research project the validity of the findings must be assessed. Locally used academic papers and resource publications were used. A different bibliography addressed each section of the localization process. Several specialists contributed to the study to ensure accurate results. Specialists will be surveyed, however the small number of specialists surveyed might affect the accuracy of the findings. Future studies should take this into consideration. This Thesis was written with an impartial attitude. The final framework design is based on various bibliographies and methodologies, which proved efficient in application, but conclude with the groups interviews. As previously stated, this step could not be achieved without the participation of different members of the company who contributed to and approved the suggested framework. The next section presents the structure used to achieve a framework for software localization.

#### 1.4 Structure of the Study

This study is described in five different sections. The introduction introduces background information about the company and its problem. It also describes the structure of this Thesis and the research question; additionally, this section explains the underly-

ing theory of action research. The “Current state analysis” describes the current state of the localization process and its current problems. The “Lean manufacturing, Scrum and Six Sigma” section describes all relevant theory for design of the desired framework for process improvement in software localization. This section has a solid description of Lean Manufacturing, Scrum development and Six Sigma. Another topic covered in this section is the explanation of what material was used in this Thesis. The fourth section describes the framework created after theory analysed in section three. The fifth section presents the results and analyses of the study executed in this Thesis. This document concludes with a summary. The Figure 2 represents a graphic perspective of this Thesis structure.

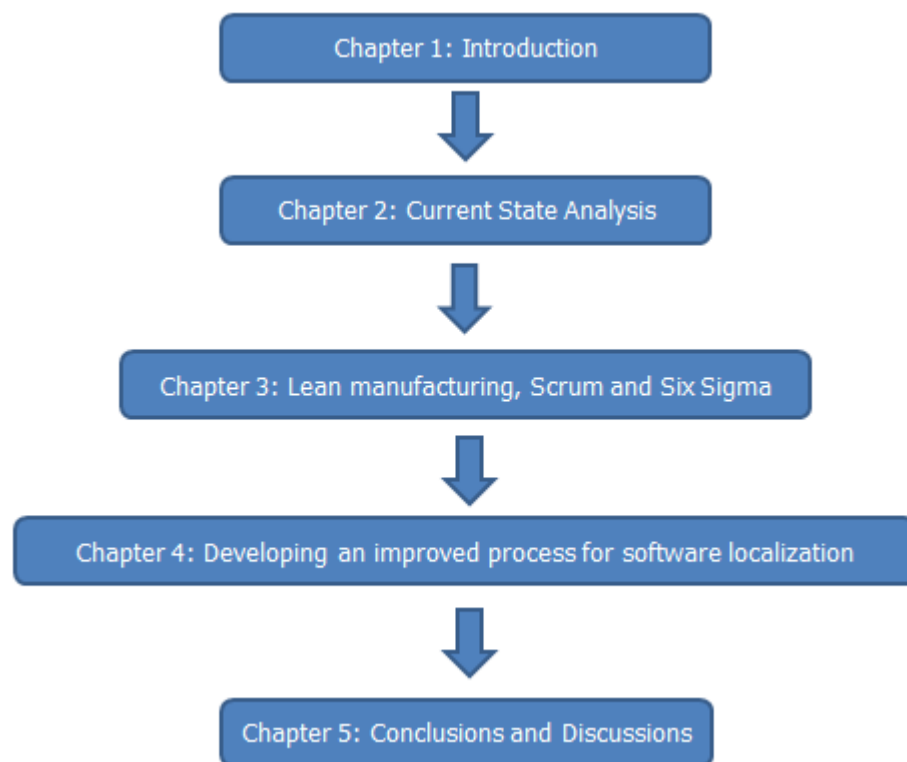


Figure 2. Thesis structure.

## **2 Current State Analysis**

This section was written to explain the initial localization process before improvements. The three major challenges were lack of synchronization between engineering team and localization team, lack of communication between teams and team members, and several problems in the localization process itself. The three different issues are analysed below.

### **Lack of synchronization between localization team and development**

Lack of synchronization between the localization team and the engineer team presented a major challenge to the team.

The team needs several pieces of information in order to start a translation round. Mainly the team needs all information from the development team; this will span from UI specs to file naming and feature background information (description). After collecting all the information the translation round begins. When the translations are ready they are sent back to the company. At this point, the company will integrate the translations with the software in order to create a build to send for testing. After the build is complete, the testing takes about one week, but varies depending on the amount of work to be completed. After testing the bugs are sent to the localization vendor for bug fixing and the test report to the company. As a final step, the localization vendor will send the corrected files to the company for integration with the system. After this the localization team notifies some of their customers (in this case internal teams) that localization is complete.

To test the software, the localization team requires a stable "build". This build was only available by the end of the third week, forcing the localization team to take five weeks to execute their tasks, and not align with the three week cycle of development. As a result, the localization team was always delayed by two weeks in comparison to the development team, causing delays to release the product. The localization team began executing localization testing after the third week in order to guarantee that all fea-

tures are implemented for testing. Figure 3 shows a simple graphical representation of the process.

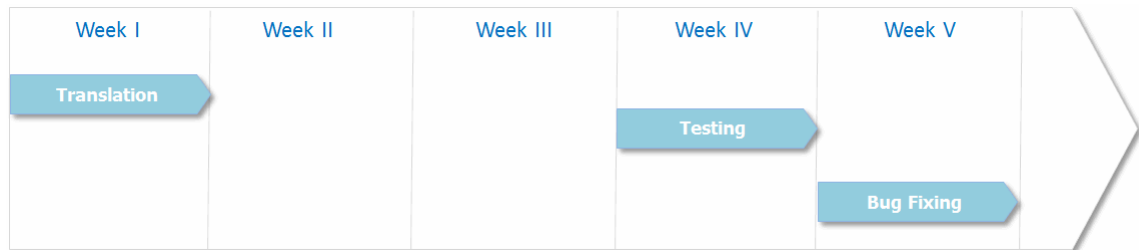


Figure 3. Original Software Activities in the user case company localization team.

#### Lack of communication between teams and team members

The localization team faced another problem - poor communication between the localization team and the scrum team. Frequently the development team executed different changes to the software without notifying the localization team. These changes would impact the localization team. The team could not tackle these problems without any communication. These changes were quite critical since the localization team could not identify the origin of errors occurring during the testing phase.

#### Problems in Localization process

At this point there were several types of errors identified by the internal team; UI truncations, incorrect translations, or contextually inappropriate translations. These errors could be related to external vendors or changes made by the engineering team. At this point it was quite difficult to identify the source of these problems. This is why a proper process improvement framework is necessary. Identifying solutions was impossible without knowing the source of the errors. The pass rate for localization testing was between 80% to 90%, resulting in internal dissatisfaction and increased costs. These errors were costing the case company 150000€ per year, or one fifth of the annual budget for localization.

Since one of the objectives of the Six Sigma framework is to provide a deep analysis of the current status of the process, deeper analysis is included in section 4.

The next section introduces the lean, scrum and Six Sigma, because these are the methodologies used by the case company. At the end of the third section, a theoretical framework for process improvement of software localization is presented.

### 3 Lean, Scrum and Six Sigma

To make process improvement possible, it is necessary to have a good theoretical background of the essential disciplines involved. The introduction gave good background information about localization without going into too much detail. The objective of this Thesis is not to explain localization in detail; the user should already be familiar with the topic. The first part of this section will explain what “Lean Manufacturing” is. Toyota made this methodology popular by achieving numerous improvements in quality and time. This methodology offers several tools for improving collaborative work between teams, tools for identifying waste in the process, and reduction and tools for improving communication. The second part represents what can be called an evolution from lean manufacturing to lean software development. Scrum is a lean software methodology. The main objective is accelerating the marketing speed while maintaining maximum value of the software. As the local engineer team uses this approach, it was needed to build all the localization process around this methodology. Six Sigma is a process improvement methodology. This methodology is explained in third part of this section, this methodology provides foundation for the process improvement framework explained in the last part of this section.

#### 3.1 Lean

Lean thinking is also known as lean manufacturing. A management philosophy which aims to maximize the value of the products and services while reducing waste. To achieve this, management uses a combination of methods, techniques and tools oriented to the simplification and optimization of the processes, and reduction of activities and less valuable. (Van Assen et al 2008:147).

For Womack and Jones, waste is any activity which does not result in an increase in costs, time and dissatisfaction of the final customer. (Womack 2003:15) To understand this thinking, it is important to understand the definition of value and waste. Value is everything that justifies our attention, time and effort given to something considered worthy. Waste is all activity performed without increasing value. The Japanese call these activities “muda” because they consume resources and time, making the final product more expensive than it should be.

The competitive advantage is measured by comparing what companies create with what they ask in return.

In Liker's opinion (2004:28) there are seven different types of waste; for the purpose of this Thesis four are presented. Overproduction is the first type of waste, this type of waste is the opposite of just in time production (JIT). Over production means producing more than what is necessary; this kind of problem is quite common in localizations teams. For localization, teams tend to deliver more than what is necessary, thus wasting money on unnecessary translations. Waiting refers to the time that people or equipment lose in anticipation; in this specific team, members must wait for a proper build to be in place. Over processing or incorrect processing create waste. Defects or quality problems found in products and services also produce waste.. The team's current process includes a lot of waste.

Womack (2003:15-101) identifies five principles for achieving desired results. . Product developers are responsible for creating value in products and services. This is a critical starting point for lean thinking; value can only be defined as meeting customer needs at a specific price, at a specific time. The value stream must be identified, the organization must satisfy all stakeholders, and simultaneously take responsibility for delivering value; naturally each interested party must define their respective value streams. Flow must be optimized. All steps in the chain must be synchronized in order to create optimal value. The lean thinking philosophy uses a pull system approach which aims to produce needed products, seeking to end unnecessary production of material. The final principle is perfection and continuous improvement; finding ways to do things better, faster and cheaper.

Lean thinking is a management and leadership model which encourages problem solving value development. The lean thinking management model seeks to reduce or eliminate waste during the development process. Creating a lean company begins with recognizing that customer satisfaction requires a small portion of company time and effort. After identifying product value, all activities which do not increase are eliminat-



ed. The company becomes more flexible and efficient by removing waste and reducing cost.

Lean thinking companies aim for continuous improvement; the Japanese call this philosophy "kaizen". Depending on the type of the company, continuous improvement should provide a superior quality of products and services and will aim for the implementation of a culture of constant improvement. In order for an individual or organization to develop habits for continuous improvement, it is necessary to understand why improvement is necessary. This is relevant for our case company. The localization members understand the process, and can identify areas for improvement. Motivation is equally important to completion. Continuous improvement cannot be imposed, a worker can have the knowledge and tools necessary for improvement, but if he is unmotivated, he will not.

There are three important components to continuous improvement: allowing mistakes in order to understand why they are made; second, rewards for developing solutions; and third, people are encouraged to continually develop better solutions, and maintaining a culture of continual improvement.

The continuous improvement approach is not like other management philosophies. It is not a quick solution, or quick improvement. Continuous improvement is based on continuous evolution; little by little improvements become more visible, while allowing time for adjustments to new processes. The use case company is looking for more efficient improvements than incremental change. Each step toward continuous improvement is supported by a cycle of Plan, Do, Control, Act. This cycle is repeated until perfection is reached. At each step, there is a standardization procedure to prevent recidivism, represented in the Figure 4.

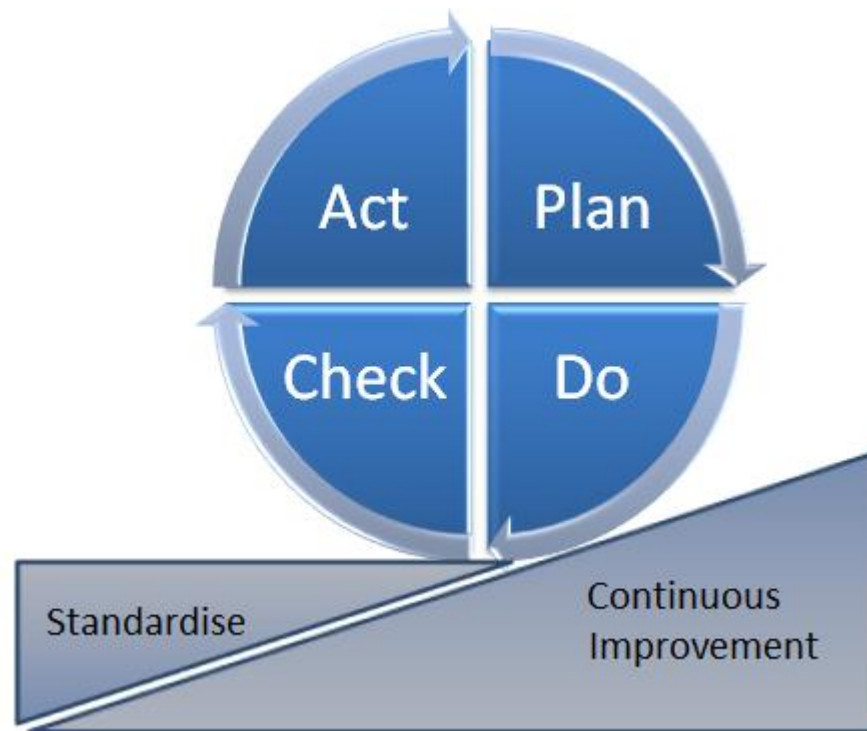


Figure 4. Continuous Improvement - Adapted from Rother(2009:12).

To create an employee mind-set of continuous improvement is not an easy task. Usually there are multiple problems, increasing the complexity of solutions, even good ideas are difficult to implement. Most of the companies only address problems when they appear. Usually this "quick fix" approach fails to address root causes.

Establishing a "kaizen" mind-set is a crucial. Naturally this is the responsibility of top management.

The remaining question is: how does the company implement a continuous improvement mind set into company staff? Toyota's strategy can be taken into consideration. There are several elements: the PDCA cycle, the communication method "Hourensou", the 5 W's and visual management.

The PDCA cycle is known as the continuous improvement cycle or Deming cycle. Although the cycle has existed since the 1930s, it was W.E.Daming who made it popular in Japan during the 1950s. The Deming cycle is a simple sequence that guides ongoing improvement, for changes in process or even for simple analysis of processes. The Figure 5 presents the PDCA Cycle.

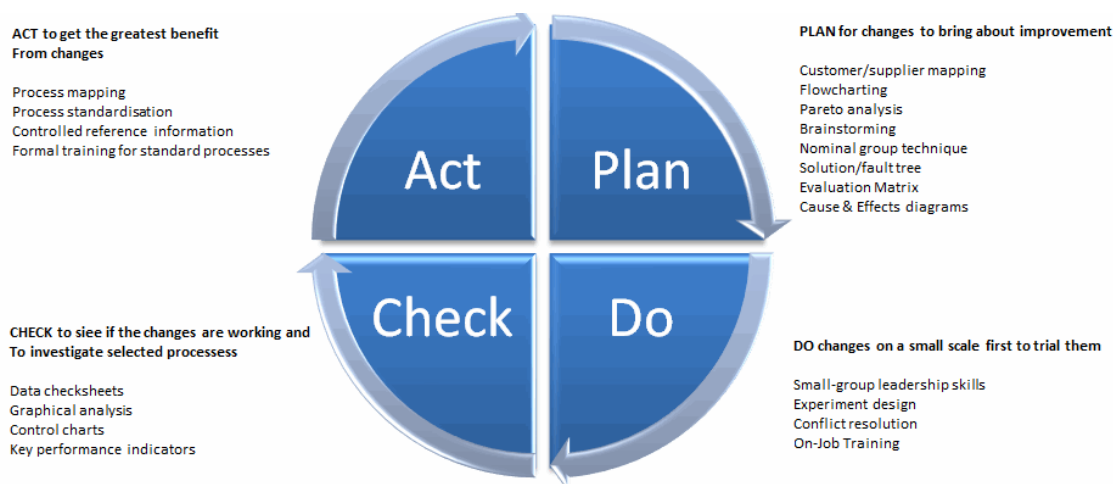


Figure 5. PDCA Cycle (Adapted – Deming 1986:103).

It is important to understand what standardization means. This step was previously referred to as the step taken after each cycle of PDCA. Standardization is defined as creating equity, regardless of who makes it and who uses it. Standardization is coming up with a consistent solution, process, or method; this will guarantee continuous improvement giving the opportunity of building something on top of a stable process while developing new improvements. Making operations standard will not only ensure security to developers, consumers, and managers. The ultimate outcome from Standardization is low variation in the processes. Running a process consistently will stabilize the process, and ensure consistent results and effective solutions.

The next element is the Hourensou. Hourensou is a Japanese method for promoting and facilitating communication between different branches of an organization. As Liker states, "this word comes from hou (hou koku – to report) ren (renraku – to give updates periodically) and sou (sou dan – to consult or advice)". This method was conceived so that line operators will be able to report information continuously, so that management can make informed decisions (Liker 2004:233).

This technique is aligned with workplace communication. The base of business success is team work; bad communication or inclusive decision making is detrimental to team work. Communication contributes to information sharing and promotes friendship between colleagues, while communicating production standards.

The third element is the use of the 5 Whys technique. This technique is used to locate root causes and avoid focusing on peripheral issues. Using this technique deeper anal-

ysis, and identification of root problems. This technique is simple. First to the team must identify the problem, and second, ask why it happens. These questions must be posed in regard to each potential cause, and repeated five times. At the end, the researches will have located the root causes (Derby et al. 2006:85). It is ordinary to have more than one root cause, so it is important to identify different solutions.

The fourth, and last, element is visual management. This is a support process for increased operation efficiency visibility, logic and intuition. Many companies use this approach to make the processes simpler and less dependent on computers and formal procedures. This kind of management can be seen in different ways. For example, signs on the walls, symbols painted on the floors, different coloured cloths for different departments, etc. A company that is able to use this technique effectively is able to put an outsider inside the company and consequently, will be able to locate the necessities.

The next part of this section focuses on tools or techniques used to achieve for waste reduction.

#### Value Stream Analysis

This method allows visualization of product or service development throughout the value chain. This method is relevant to the use case company, which works with different vendors and teams; this method allows the team to visualize the full chain instead of concentrating on a few aspects. Mapping the process requires flow of materials and information; which contributes to visualizing the process contributing to future process development. This tool decreases wasted time. The Figure 6 presents an example of a Value Stream Map.

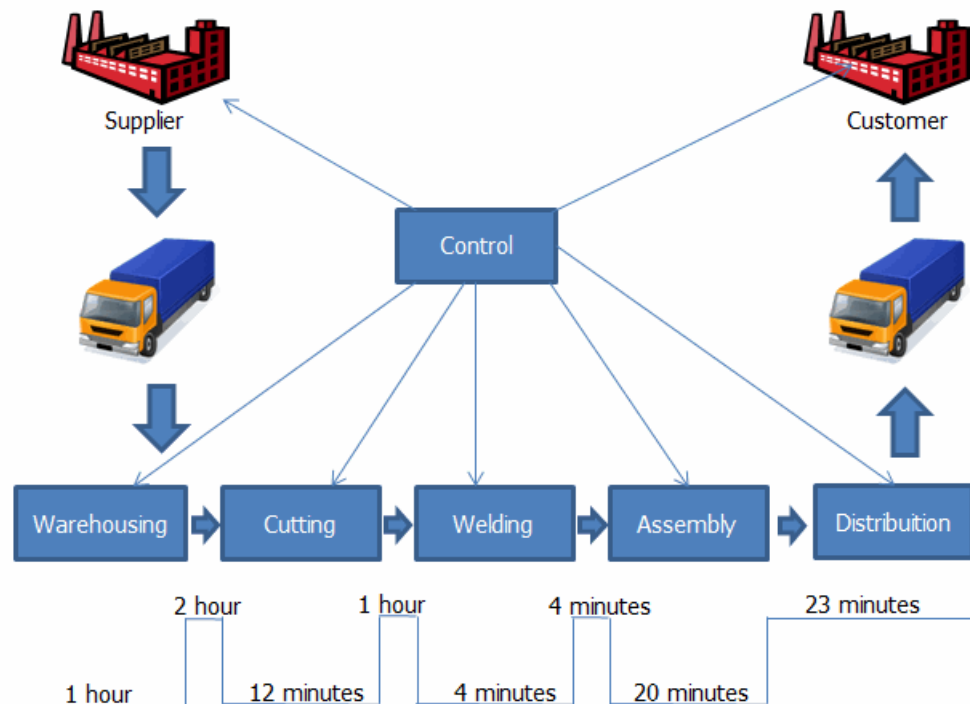


Figure 6. Example value stream map (Adapted from Van Assen et al 2008:235).

This tool allows the visualization of more than one process at a time. It allows visualization of the whole value chain, rather than one part of the process. As it was said before, waste throughout the chain is easily identified with the use of an easy, common, simple and intuitive language. This tool shows the connection between material, capital and information flow, creating the base for implementation of a plan. (Liker 2004:275).

### Cause Effect Diagram

This technique is usually called Cause Effect Diagram or Ishikawa diagram. This tool is used in problem solving brainstorm sessions and analysis. Using this diagram, it is possible to analyse cause and effect. Each of the causes is broken down into sections. When this tool is used, it is important that the team must concentrate on causes, not symptoms. After identifying causes, it is important to group them in categories. After identifying main causes, the next step is to find sub-causes in each category, in order to identify root causes for each problem. It is common to use the 5 W's technique. The figure 7 shows a graphic display of this tool.

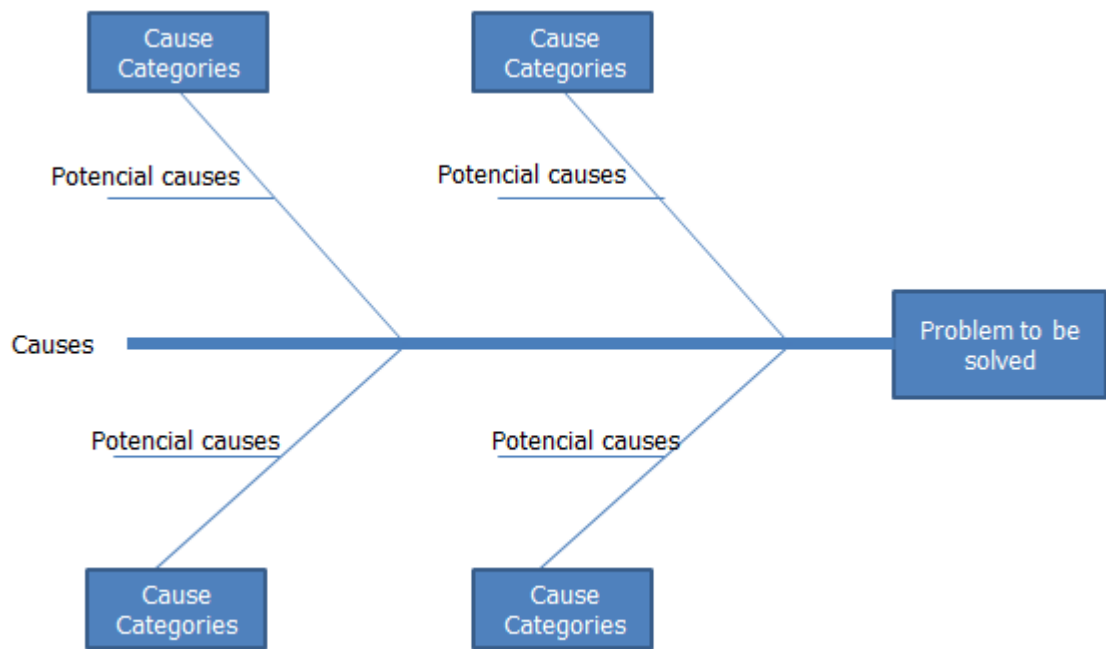


Figure 7. Cause-and-Effect (Adapted from Pande et al 2002:250).

This section describes lean thinking and various tools. The section may appear irrelevant to this study, but lean manufacturing is not just a framework, but also a philosophy which is relevant to this study. Also, Scrum development is a lean software development framework. To fully understand Scrum it is important to understand its origin. As Jeff Sutherland states in his paper, Scrum was designed to allow teams to become more efficient. With the help of insights by Ikujiro Nonaka, it is now used worldwide.

### 3.2 Scrum

Software industry has had difficulties for many years; participants change but the problems remain. Most of the software projects are delivered too late and over-budgeted. When a project is delivered to stakeholders, they may decide the product does not meet their needs.

Toyota and Dell are taking a leaner and more flexible approach. With this change, they aim to obtain a “business value-driven” approach.

In Waterfall approach, there are numerous problems related to customer requirements. Customers usually do not know their needs until they see the final product. In many cases the product does not address customer needs. This problem, Waterfall problem, is a “wicked problem” (McConnell 2004:232). Examining localization is crucial, because when the product is delivered, a significant amount of money has been spent. At first glance, this is not so negative because translations do not change even if the requirements change. On the other hand, in most of the cases, this can be crucial since the UI frequently suffers severe changes, making the translations unusable. But this is not the only problem; on the Table 4 there are several reasons why companies choose to move to agile methodologies.

Table 4. Reasons for adopting Agile methodologies (Versionone 2008:3).

Accelerate Time-to-Market	22%
Enhance Ability to Manage Changing Priorities	21%
Increase Productivity	12%
Enhance Software Quality	10%
Improve Alignment Between IT and Business	9%
Improve Project Visibility	6%
Reduce Risk	6%
Simplify Development Process	4%
Other	3%
Improved/Increased Engineering Discipline	2%
Reduce Cost	2%
Enhance Software Maintainability/Extensibility	2%
Improved Team Morale	1%

Agile methodologies, such as Scrum are an evolution of the lean thinking methodologies applied to the software industry. Scrum is a software development approach based on incremental interactions and quick feedback from the customer. The customer has the opportunity to review the entire product at the end of each interaction, giving immediately feedback about the product. Speaking about Localization, this saves time and money. Even if there customer is dissatisfied, it is easy to fix in the next interaction.

A comparison between Waterfall and Scrum can be observed on the Figure 8.

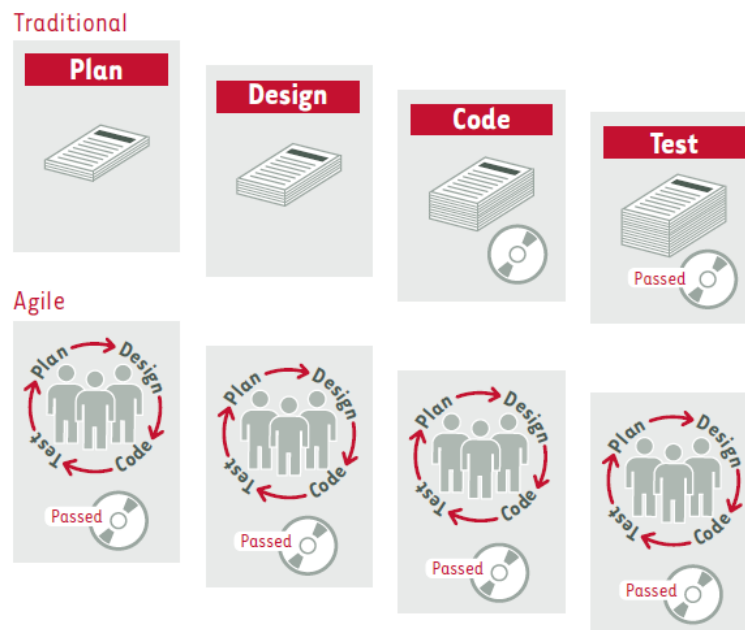


Figure 8. Comparison between Agile Development and Waterfall (Versionone 2008:4).

The agile manifesto shows twelve different principles. The biggest priority for scrum users is to satisfy the customer by delivering timely and continuously valuable software. Requirement changes are welcome; if the customer is not able to change the requirements, it means the software is not able to satisfy customer needs. Companies are supposed to deliver the smallest packages of working software possible in small intervals. For the success of the project, it is crucial to have business people working closely with the development team; this is the only way to ensure that both parties understand each other. Empowering individuals to get the job done. Face to face communication is most effective and efficient within a development team. The progress on the project is compared to previously delivered software. Sustainable development is promoted in agile processes. Quality and design of the software enhance agility. Self-organized teams usually produce the best architectures, requirements and designs. The simplicity of focused activity and proper prioritization saves time. Last but not least, the team has frequent opportunities to analyse outcomes.

There are two important roles in a Scrum team. The first role is Scrum master; the Scrum master is responsible for removing any impediments that prevent the team to



proceed with the work. The Scrum master usually works as a team leader, illuminating best practices to other members. The second role is product owner is. The product owner represents the business part, giving, specifying and prioritising the requirements. These requirements are recorded in the product backlog, which is a list of features that must be implemented in order to achieve the desired product.

In Scrum, a sprint is defined by time boxes interaction of a month or less. During these sprints, the team builds fully designed, coded and tested software based on product owner priorities. These sprints are fed by the product owner who is responsible for deciding which stories should be implemented. By the end of each sprint, the product is ready to be shipped. This is one of the big goals of Scrum. It is ordinary to have a retrospective meeting at the end of each sprint, which serves as a learning exercise. The figure 9 illustrates Scrum approach well.

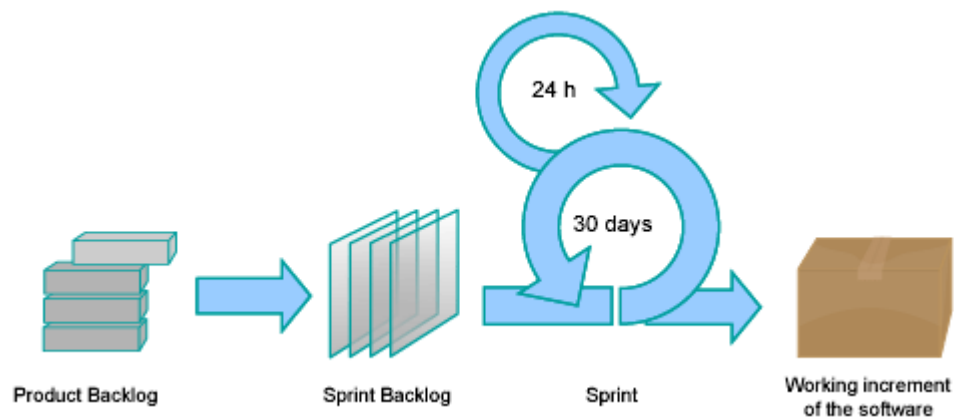


Figure 9. Agile software development (Armsol 2009).

It is important to understand this approach in order to allow the localization team to provide better methods to the engineering team.

The next section explains a process improvement framework called Six Sigma.

### 3.3 Six Sigma

"Six Sigma, a new name for an old vision: near-perfect products and services for customers" (Pande et al 2002:3). Six Sigma is a methodology created by Motorola in 1986. The objective of this methodology is to prevent development of defects and errors, minimizing the variability in manufacturing and business process; the output is the improvement of the quality of the process.

More and more companies are using Six Sigma to improve their processes and their customer satisfaction. These are difficult times; competition is getting tougher, and customers are getting more demanding. There is no much space for errors. If a company wants to survive they will need to understand what the customers want.

The society has changed; many modern companies produce services instead of products, this is happening as well with the use case company. These companies need to improve their processes. Some companies' efficiency is so low, that they would close after a month if they were actively manufacturing. This is where Six Sigma can help. Six Sigma already provided great results for companies like GE. But Six Sigma is not just for manufacturing. Service companies like Amazon and Ebay, as well as hospitals and public service organizations, are relying on Six Sigma.

Service companies usually use average values to report business results; average cost, average delivery time, etc. This is not the most efficient method. At some point, all of us have waited more than the average time for delivery of some goods. That is the problem; customers notice the variation, not the average. Six Sigma metrics focuses on understanding how often the product/service fails to meet customers' requirements (a defect), by looking at how much variation there is around average.

After understanding how much variation exists in the process, the company is responsible for eliminating variation. That variation is responsible for defects; preventing defects is one of the big objectives of Six Sigma, if a company achieves this, it will provide excellent service. Pande et al state that there are six different ingredients in Six Sigma for a company to deliver Excellency (Pande et al 2002:8-10).

Genuine focus on the customer

Sometimes companies say that "Customer is number one" or "the customer is always right". But not many companies actually do something to improve or understand the

actual customer requirements. For example, often consumers find themselves waiting for the cable installer for long periods of time. It would be more efficient for service providers to make appointments with consumers. Usually this cannot be done because companies do not control their own internal processes; this is in the key aspect of Six Sigma. The customer focus is always the top priority. Performance measurement begins and ends with the Voice of the Customer (VOC). If the needs of the customers are not met there is a "defect". First step for process improvement is defining customer requirements and goal acquisition.

#### Data and Fact Drive Management

Today's world is full of information. The internet is a great phenomenon, one can find almost all information one needs there. But there are still a lot of managers making important business decisions on a daily basis based on personal feelings and not research. It is true that managers receive a huge amount of reports with various data, but mostly these reports do not show anything. This is something that is solved with Six Sigma; Six Sigma teams clarify which measures accurately gauge business performance. Six Sigma can give answers for questions like: How is the company really doing? How does that compare to where the company wants to be? What data is needed to answer other questions?

#### Process Focus, Management, and Improvement

It is not unusual to hear from our managers that process kills innovation and makes companies stiff. This could be one of the most important steps of Six Sigma – Mind set change. Mastering and improving process is the only step to build competitive advantage by delivering real value to customers. Since Six Sigma, as mentioned before, focuses on the process as the key point to meet customer requirements.

#### Proactive Management

Six Sigma needs proactive management; managers must not wait for moments of crisis to tackle problems. They must always try to improve the process and the performance of the business by setting ambitious objectives. These objectives challenge the way things are done inside the company. A company that is losing control is a company that spends too much time on emergencies, and expensive quick fixes. This is another issue that Six Sigma addresses, a method for moving from reactive to proactive man-

agement. What with the difficulties companies face today, this is the only way to solve them.

#### Boundary less Collaboration

Nowadays billions of dollars are spent in companies because of bureaucracy. Departments fight with each other instead of working together to achieve a common goal: "providing value to key customers". Usually Six Sigma projects affect the whole organization, forcing collaboration between teams and departments. This is not just about how to come up with a solution that will give more value to one or several departments; this will bring an improvement to the whole organization. Keeping customer requirements at the heart of the process, the company needs to find a better way to provide a service or product that will ensure customer satisfaction.

#### Drive for Perfection, Tolerate Failure

As was already mentioned, Six Sigma aims for perfection, though everyone knows this is not possible when the company is currently solving problems. It is natural to encounter setbacks; this is something that Six Sigma managers need to be prepared for. If no changes are made, the process will never improve. The biggest risk for the team is to never try anything new. Six Sigma contains many Risk Management tools, but there is always the probability that something bad happens, that is why they need to be prepared to manage and learn from it. Challenging existing processes is the only way to achieve innovation and better processes.

Companies that use Six Sigma will probably achieve a big financial return – ROI and a transformation in workplace culture. They will be driven to improve strategy and will use the data available to make better decisions.

Harry et al. opinion (2010:25) states that Six Sigma is about leadership more than tools, systems, methods, etc. Even if these things are crucial for Six Sigma to function, he believes that companies that have strong leadership and weak knowledge of Six Sigma can perform better than companies that have a strong understanding of Six Sigma but poor leadership. He strongly believes there is a huge difference between leaders and managers. For him, managers are people who create policies and procedures and ensure compliance between them. They are not risk takers, and they value

the peace that comes with predictability. Most of these people are dedicated to preserving the organization, rather than moving ahead. On the other hand, leaders force others to confront faulty beliefs and values. They provide direction, vision and inspiration. They support new ideas, innovations, beliefs and values. Six Sigma forces the organization to go into unknown territory; for this kind of change the company will need a leader, and only a true leader is able to produce a true cultural transformation.

### Three ways of Six Sigma

Six Sigma has three different parts with one thing in common- the process output, this parts can be seen on the Figure 10.

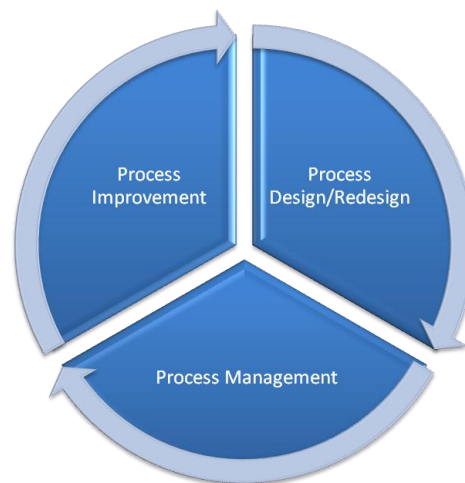


Figure 10. Three engines of Six Sigma (Adapted from Pande et al 2002:13).

### Process Improvement

Process improvement is the process of finding root causes for existing problems, and generating a new problem-solving process that leaves the basic process intact. This kind of approach is applied in existing process. In Six Sigma, it is commonly said that there are critical Xs (causes) that creates the unwanted Ys (defects); using a five step process to tackle these defects, this process is illustrated in Figure 11.



Figure 11. Process Improvement Steps (Adopted from Pande et al 2002:15).

### Design for Six Sigma

This step was not explained in detail since it is outside of the scope of this Thesis, so only a brief explanation is provided. The situation described above fits perfectly into situations where a company has a process in place which requires improvement. However, this is not always the case. There are situations where the process is so poor that it is better to redesign it from scratch. Another circumstance is when team leadership discovers that changes in the process will not deliver the required quality to the customer. When the organization identifies a niche for a new service or a product, a new delivery process is necessary. This process can be named in several ways but the most common way is: "Process Design or Redesign", "Six Sigma Design" (SSD) or "Design for Six Sigma" (DFSS).

### Process Management

As previously stated, before Six Sigma requires a Cultural transformation within the organization in order to be successful; Process management focuses on managing functions of various departments rather than processes across the organization. Without process management, Six Sigma is doomed because it requires a fundamental makeover in the way an organization is structured and managed. Process management

includes the definition of the process, key customer requirements and process owners. Six Sigma is a top down initiative carefully designed to align the entire organization. On the highest level are the business executives who defines the business goals creating a reward structure that ties the rewards to the improvements, these goals are then passed to the middle operational management, these managers are owners of process where DMAIC can be applied, reducing effects and cost, these improvement projects are given to the Black Belts or Green Belt people so they can fix the broken. That's why it is common to say that Six Sigma is a Top Down initiative.

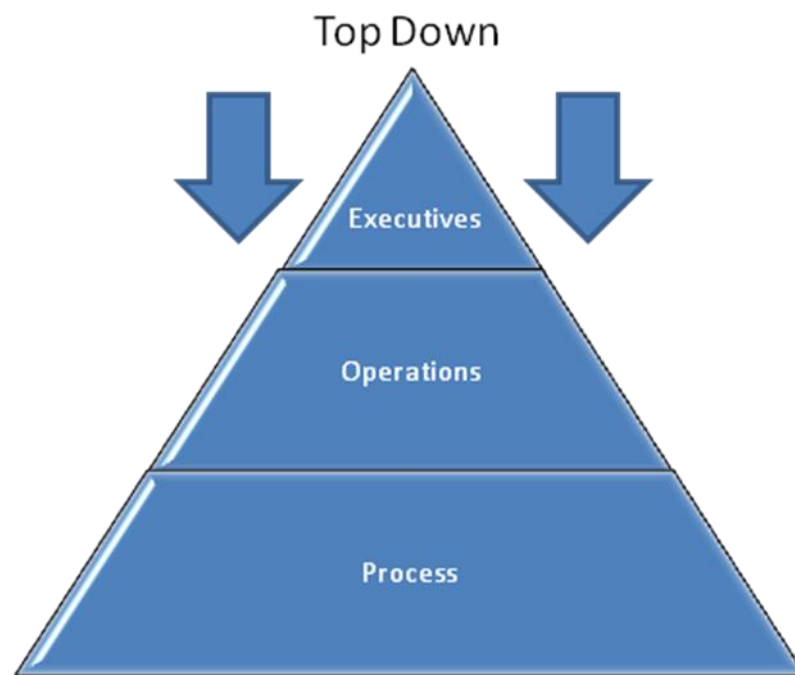


Figure 12. Six Sigma Top Down.

### Team

It is not enough to have leaders and commitment from management to be successful; the right people need to be in place. A true Six Sigma team has different kinds of people; all of them are important but there are different roles for different people, which are presented below.

Executive Manager – Are responsible for driving Six Sigma culture into the organization and align it with the strategy, these are the ones defining the initiative goals and providing resources.

Project Champion – Identifies and shepherds projects. They are able to ensure the success of Six Sigma implementation by identifying focused application projects.

Master Black Belt – These persons are responsible for training and coaching the Black and Green belts.

Black Belt - Full time project manager and leader on larger projects.

Green Belt – Part-time project leader or support of Black Belt projects

Yellow Belt – Supports projects or interfaces with projects teams from an operational perspective

All employees – Applies the normal Six Sigma concepts to the daily job.

The Figure 13 shows in a simple way what was described.

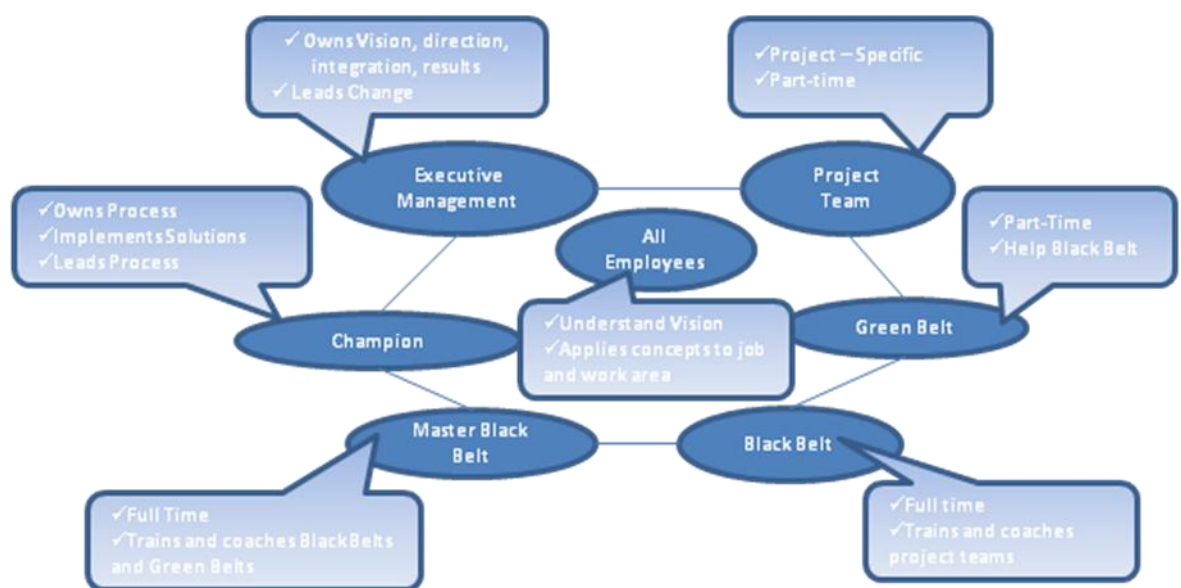


Figure 13. Six Sigma Team.

Theoretically an explanation of project selection should be presented, but for this Thesis the project was already selected, so this section is absent. This being said, a description of the DMAIC framework is included.

On the figure 14 the road map of the DMAIC framework is presented.

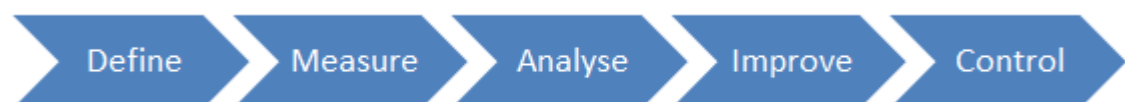


Figure 14. DMAIC Road map ( Adapted from Harry et al. 2010:31).



### 3.3.1 Defining

The objective of the Define step is to identify the problem create the project plan for developing a solution. At the end of the define phase it is possible to create a project core charter that includes: a concise problem statement, defined output metric, goal, and impact on the business. A project charter will be presented as well that contains the time frame of the project and the team members. Another important step is setting project boundaries; this includes SIPOC creation and a high-level process map. The define phase will be over with customer identification and the respective CTQs.

#### Project Chart

In Pand et al opinion (2002:74-79) the Team Charters have seven different aspects.

The business case is a general definition of what the issue is and a small explanation of the specific issue within the organisation. As stated previously, Six Sigma initiatives have their start on the top management, so is the champion or the executive team defines this.

The Business case defines the next step to clarifying the "Problem Statement". The problem statement is a short description of the problem that needs to be fixed, usually the problem statement answer questions like: "What's wrong?", "How big is the problem?" and "What is the impact of the problem for the business?"

After the "Business Case" and the "Problem Statement" are defined, the "Goal Statement" should be defined. This includes a description of what's to be accomplished, including target results, and identifying a date for project completion.

An important topic is the scope of the project. It is quite important to define this part; an important part of any project is expectation management and if the team does not clearly explain the scope of the project, they will encounter problems when confronting consumer expectations. Here, the Champion communicates constraints and assumptions.

Team guidelines and membership can be the next phase. Here the team members should write down their expectations of the team; how they expect the team to work, and suggest potential ground rules, including team member responsibilities to the project.

Having a Gant chart is a great way to define a “preliminary project plan”, the team must know what the dates and schedules of the project are, which will help them stay on track.

At this point a Stakeholder analyses can be performed. It is important to identify stakeholders. In these kinds of projects there are several entities involved, top management, team members, suppliers, internal customers, external customers etc. The team must ensure that all concerns are addressed. If this analysis is not performed, there is a big chance that some of the stakeholders will seriously impact project development.

#### Customer Requirements

After defining the Project Charter, customer requirements should be identified. There are several ways of doing this.

#### Customer Segmentation

The goal is to make sure that not all customers are the same, each group of customers has different requirements and different needs. Putting the customers in company designated segments can help team members identify a specific strategy. If the company decides to perform this exercise, the first thing task is choosing a product or service to study. After that they should brainstorm to identify potential customers for this product or service. Identifying the product or service requires identifying characteristics that will influence that consumer group and developing profiles of key segments. It is important to include different data from different segments, such as surveys or interviews, and to document results.

#### Types and sources of customer data

Usually the company has this kind of data already. It can be found in the sales department product and service sales records. In our use case company all the necessary data is available in the form of test reports. Another department where the companies have a lot of access is the customer care department, usually this department has a lot of information about customer needs and complains. To obtain external customer data,

companies usually use direct and indirect research methods such as interviews, surveys or market trends. This exercise of collecting customer requirements is called VOC (Voice of the customer).

#### Identify the process

The final step in the Define phase is to identify the High level process; this will help the team focus on the problem.

This High level process can be done using a simple flow chart with no more than four or five steps. This technique is called SIPOC, and is used quite often as well. Of course if the company wants to use both, it's even better.

In the Figure 15 normal mapping elements are presented.

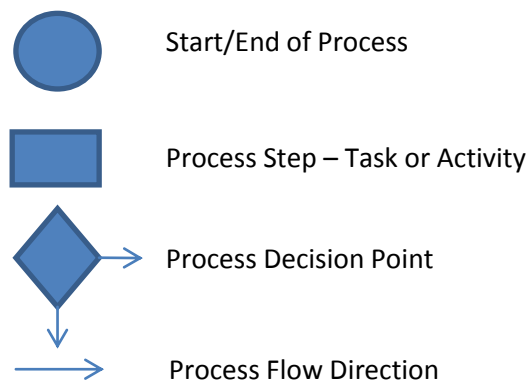


Figure 15. Elements of a basic Process.

The SIPOC technique is a high level map representing a business process where it is possible to identify the process boundaries, and the company can observe product and service delivery.

Using Pand et al definitions (2002:94) of SIPOC: Suppliers are information providers, processers and contributors. Input is all the information given by Suppliers that is consumed by the process. Processes are the steps that transform the Inputs. Outputs are the product and services that will be used by the final user. Finally, the Customer is everyone that will use the output from the process. This was the last part of the Define phase; the next part will be the Measure part.

### 3.3.2 Measuring

The goal of this part is to measure the current process performance while focusing on areas where most errors occur. At the end of this phase, it will be possible to establish data collection plans for key process metrics, verify the data quality, and stratify the data. This phase is identifying the Cost of Poor Quality.

Before any measure be taken, it is quite important to observe the process itself. Observing the process and the service provided to customers. It is extremely important to identify problems early, and to understand the process and how to measure it. "If we can observe an event (or even its' effects) we can measure it. If we can measure it, we can improve it." (Pande et al 2002:128)

One of the most important parts of the Measure phase is to understand what kind of data will be used. This will influence how the data is collected and what lessons are learned. George M. L. et al. (2005:70) explains the different types of data:

Continuous: any variable measured on a continuum or scale that can be infinitely divided. Examples: Cost or Prices, height, weight, temperature, etc.

Discrete: any other type of data that is not continuous. This includes: the number of errors, number of defects, number of calls, etc. Data that has only two possible values, for example "On/Off", "Pass/Fail", etc. The data has names or labels but they doesn't have any specific order for the labels, for example: "Defects on a car: Doors, Mechanical, Wheels, etc. The names or labels represent some value connected to the object or item, for example: "Quality of the Service X: "Very Poor, Poor, Normal, Good, Very good", etc.

It is quite important to know what should be measured and if necessary, now with so many IT systems, it is really easy to get tons of information. But sometimes most do not have any interest, and the information only distracts the team from what is actually important.

It is important to measure the efficiency and the effectiveness of the process. This is a good opportunity to analyse the focus on volume and cost of consumed resources in the process. It is possible to analyse how the product or service looks to the final cus-

tomer. One must not forget to identify how inputs can affect the outputs of the process, after defining this, the team can revert to the process in order to identify the problem.

This is important as well, the team should really focus on locating measurable variables, several teams in several different projects must return for remeasurements because they measured the wrong process or they selected the wrong items to measure. It is crucial that measurement be normalized where data collection can be defined, documented, studied, and improved.

At this phase it is quite important to remember what the problem stated was in the Define phase, along with critical customer requirements. Most of the times the measurements are based on customer complaints and defects in the output process. Here the team needs to pay attention to which questions must be answered, and what data is necessary.

To identify the Measures the team can use a quite popular tool called CTQ tree. This diagram is like a tree chart, but the main focus here is to define measures that are critical to the quality. This technique moves the high level into detailed specifications and ensures that all aspects of a CTQ are covered. Figure 16 shows a CTQ Tree.

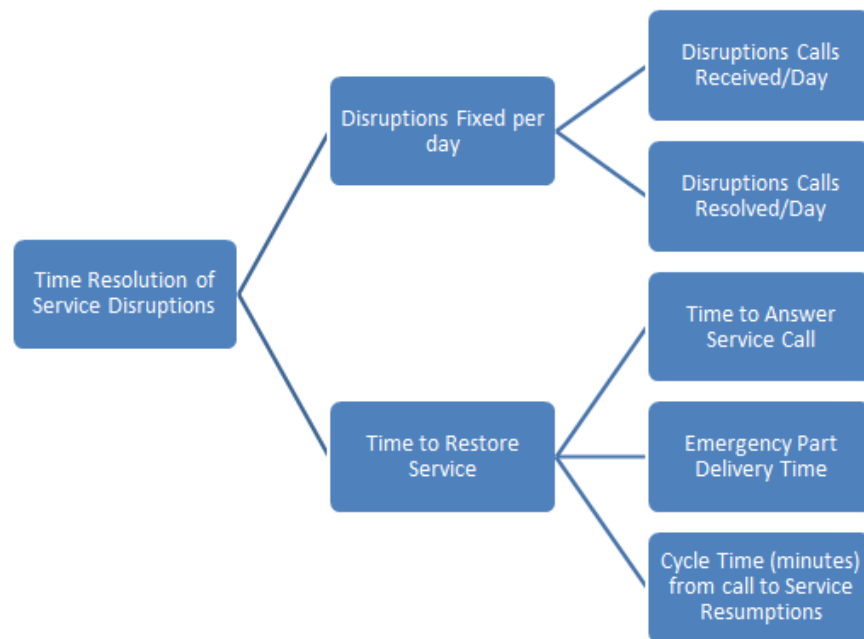


Figure 16. CTQ Tree (Adapted from Pande et al 2002:135).

Another way to select areas for measurement is using the stratification technique, this technique allows the teams to separate data into different categories for later analysis. The data can provide clues to root causes. This technique is important when the team wants to analyse a product sold worldwide and they want to see data by state or region, or by demographic factors such as gender, age, etc. There is something that needs to be done before the data collection starts, the team needs to create an operational definition which will describe what is observed and measured. This must be done, otherwise people don't have clear definitions of "defect", "problem", "product", "service" etc. and different people will measure different things. With a proper definition, all team members will collect data in a standardized way.

Sometimes a company has the data ready for analysis, but the available data is historical data. Teams must be careful with this kind of data, as it is not always suitable for the job, especially if the data was collected for other reasons than an improvement project, or researchers used different operational definitions, or the data is structured in a way that will be difficult to analyse. If the data is not available, then the teams will need to collect it from scratch, knowing what they must collect.

It is important to prepare and plan data collection, and develop a Sampling Scheme. Sampling is the process of collecting only a portion of the data to represent the whole group. The team needs to be aware that statistics based on samples are more uncertain. Two common mistakes can occur: Sampling Bias and normal random errors. Sample bias can be avoided by choosing a valid sampling strategy. The most common type of sampling bias is convenience sampling (collecting data during times or in places that provide easier collection) and judgement sampling (making educated guesses about which items or people should be sampled). For this Thesis there was no problem, since the localization team could use all the available data, so there was no need for sampling.

The next step is baseline defect measurement and identifying improvement opportunities. The team needs to understand and take into consideration some important terms. "Defect" is any condition that does not meet the specification of a CTQ. "Unit" is an item produced or processed. "Defect Opportunity" is any event which can be measured that provides a chance of not meeting a CTQ.

This phase addresses the cost of poor quality. The cost of poor quality is important. Cost of poor quality is any cost that would not have been avoided if quality were there, the cost of poor quality must translate the quality issues in financial terms for all to understand (Pande et al 2002:156). The Measure phase is over, next part will discuss the Analyse phase.

### 3.3.3 Analysing

“Becoming a Defect Detective” (Pande et al 2002:197), this is one of the main objectives of this phase; figuring out why defects occur, and focusing on the Xs of the process. Another big objective of this phase is avoiding premature conclusions.

At the end of this module, it was possible to identify problems and opportunities, utilizing the cause and effect diagram in order to identify potential causes, analysing data, and identifying the root cause of the problem.

There are two paths which the teams should follow to get to the root problems. They should analyse the data collected in the Measure phase; with this data the team can find trends or behaviours in the process, and identify improvements relating to the cycle time level, unnecessary work, etc.

Independent of the path the team chose, there is a common path they must follow. In both paths the team must analyse and explore possibilities with the collected information. Based on this analyses, they will generate a hypothesis and potential causes. As a result, they will need to verify or eliminate the causes.

The next table resumes these steps.

Table 5. Two ways to get the root problems (Pande et al 2002:201).

Phase	Data Analysis	Process Analysis
Exploring	Approach: Examine the data gathered in the Measure phase in many ways to discover clues to the underlying cause of problems. Tools: Pareto Charts, Run Charts, Histograms	Approach: Generate process maps that capture the reality of what actually happens in the process Tools: Basic Flowchart, Deployment flowcharts
Generating	Approach: Use the lessons gleaned	Approach: Use the process maps to

Hypothesis	from the exploration to generate ideas about the cause of effects Tools: Brainstorming, Cause-and-effect diagrams	identify areas where the process steps, responsibilities, or outcomes are unclear or produce no added value . Analyse whether additional steps add value or just add cost Tools: Brainstorming, value analysis
Verifying Causes	Approach: Gather additional data or use pilot testing/experimentation to see if the suspects are guilty Tools: Scatter diagrams, Coded or stratified versions of the "exploring" tools	Approach: Gather data to quantify delays or lost time in various process steps. Make deliberate changes in the process to see if the identified problems disappear. Try the changes out on a small scale in case they do not work Tools: Data collection tools, process maps and documentation

A detailed explanation can be found below.

#### Data Analysis: Exploring

It is quite normal to have hundreds of pages with data. Most of the companies have nice IT systems where you can take all the data you need, which is useful. However, if the team does not understand what they are looking for, it's really easy to waste time without reaching any conclusion. The best approach is to understand the problem and have hypothesis for the cause of the problem. Additionally, the team can ask several questions related to frequency, impact and symptoms. To help the teams analyse the data there are several tools available, but usually the ones presented below are sufficient.

#### Pareto Chart

This chart helps the team focus on the components of the problem that have bigger impact. These charts are based on the Pareto principle that says "80% of the problems are cause by 20% of the causes". This kind of chart is used with discrete or attribute data.



### Run (Trend) Chart

This kind of chart is used with continuous data to analyse behaviours over time, and identify special causes' signals.

### Histograms (Frequency Plots)

This kind of chart is useful to show the range, amount and patterns of variation in a group of data

### Data Analysis: Generating Hypothesis

This part is quite interesting. In this phase the team will identify problems which are actually quite difficult. Usually people confuse symptoms with root causes. To really understand what the problems are, the team must closely examine the data. A great way to proceed is using the Ishikawa diagram. This diagram was previously identified as a Lean Tool for identifying symptoms and root causes.

### Data Analysis: Generating Hypothesis

Here, the team will seek to locate root causes. There are several ways to do this, but let's start with the Scatter Diagrams. This chart is mainly used to identify or measure possible relationships between factors; for example, if the team is measuring the number of errors, they could identify a relationship between errors found and test sets run. With this they could see if there is any relationship between these factors.

Another good way to generate a hypothesis is to stratify the data. This option is used to look for patterns in the data, which is quite useful when the team wants to analyse e data for different employee groups, times of the day, offices, etc.

### Process Analysis: Exploring

At the beginning of the project the team created their SIPOC diagram and their High Level process map, now is time to design a detailed process map. They need to add the process to the paper. The best way to do this is using a flowchart that represents all the small steps of the process.

### Process Analysis: Generating Hypothesis

After having the flowchart process in place one small step is necessary to begin discussion of what is wrong with the process. Using brainstorming, the team can easily identify issues such as bottlenecks, rework loops, redundancies, etc.

After this step it is necessary to perform value analysis. This step will identify which parts of the process are bringing value to the customer or adding cost to the final product. To do this the team must sum the necessary time for tasks which add customer value and divide that time by time devoted to tasks that don't bring any value to the customer. The final result will show the efficiency of the process.

### Process Analysis: Verifying Causes

Here, the team must go through all the process information gathered and trim aspects that waste money and resources. After making these changes the team must implement small test pilots.

The goal of this is to remove the activities that add no value or add cost to the final product

### 3.3.4 Improving

In the improve phase, the team finds, tests and plans the implementation of the solution for the quantified problem. At last the root cause is eliminated.

At the end of this phase it is possible to generate and select solutions to the problem, plan and implement the selected solutions, and plan a pilot plan.

This is the phase where the teams try some of the solutions they developed. Teams use brainstorming various techniques to develop different solutions, but only a few of them will be used in this phase. The team needs to decide which of the solutions are cheaper and easier to implement, but most important which solutions will produce a better cost/benefit relationship. After selecting the right solution, it will be time to implement a pilot project to validate the actions taken over in the process are actually valid and fixed the root causes of the problems. If the pilot project shows that the team located the root causes, it is time to establish changes and a full scale project.

There are a few creative techniques to help these teams develop improvements; for example, brainstorming, in which many new ideas are developed in a short period of time; reverse thinking, in which worst case scenarios are developed, in order to generate better scenarios.

After using some of these techniques the team will have plenty of ideas. There are some actions the team must take into consideration. First, they eliminate uninteresting options, and combine other options, and map a solution to the process. Of course, these ideas should always be documented.

Sometimes there is a real easy and cheap and the team just needs to implement it. Unfortunately, this is not the case most of the time. There are several solutions with different costs and different impacts. In these cases, the team should use the Impact/Effort Matrix. With this matrix, the team is able to do a more accurate analysis. This is important to mention, even if, for example, the most desired Quadrant is Low Effort and High Impact, true customer requirements may only be resolved if the team uses other Quadrants.

After all the steps, the team is ready to start their own pilot project. If the solutions are applied and the solution is correct, they should standardise the new process and expand this implementation to a production environment. But before they put it in full scale production, it is always nice to use some "Poka-Yoke" techniques; these are techniques that eliminate errors. The main objective of this technique is to prevent incorrect actions and make mistakes obvious so mistakes can be corrected. If the pilot shows that the solution was not appropriate, it is time to reconsider what went wrong, correct it, and continues pilot testing until everything functions well. Sometimes several pilot tests are necessary.

### 3.3.5 Controlling

Control is the last phase of the DMAIC methodology. The goal of this phase is to assure long-term process control, transfer full process responsibility back to the process owner, and close the project. Pand et al (2002) divides the control phase into four different parts.

### Discipline

Some project improvement initiatives that companies tend to fail, and after the improvement is implemented, companies tend to forget the process. Employees return to their normal jobs, and some control the process performance. And so the process tends to reverse. To fight this problem companies should nominate "process owners" to maintain new processes.

### Documenting the improvement

It is extremely important to document all the steps taken to improve the process; this ensures institutional memory. Involved teams often leave after project completion; for that reason, it is necessary to record information, difficulties, barriers, and best practices. The teams should use pictures, flowcharts, graphics, etc. Visual information is quite important the team which documents everything must find a balance; no one wants to read huge manuals, so simplicity is important.

### Establishing ongoing process measures

When the team starts the project, they have "business requirements". These requirements initiate the DMAIC project, and can be used as well for controlling purposes. The process owner should be responsible for preventing recidivism.

There are some tools which help the process owner. He can use histograms, Pareto charts, control charts, etc. These tools will allow the team to periodically measure and analyse process performance.

### Building a process management plan

This part is extremely important because teams can have control tools in place, and can check performance. However, if the team does not have a crises protocol, all the improvement team's hard work is a waste of time and money. The process may roll back to the initial state. Because of this, it is extremely important to create a process management plan. This process should contain a detailed description highlighting critical areas. Describing the process and identifying potential problems is not enough, these plan must explain what actions should be taken for each problem.

Six Sigma projects have the objective of improving the process and reducing the amount of errors. If the team describes and measures potential problems, it is immediately evident that there is space for more improvements. Here the team can describe

future plans for process improvements. After executing the actions described, the team is ready to close the project and celebrate the improvements achieved.

The framework for process improvement is included in the next section.

### 3.4 Resume of the key concepts

This framework was based on the theoretical information collected during the first, second and third section of this part of the Thesis and will be divided in three different parts explained during the rest of this section.

Referring to what was said in the “Current state analysis” section, there are three big issues. The first problem relates to synchronization between teams. Both teams (development and localization team) work with different cycles. Second, the team struggled with lack of communication. Third, there are the small defects in the overall localization process of unknown origin.

A framework to improve these three problems was developed. This framework is based on questions for industry specialists. A survey containing relevant questions to the three different parts of the problem should be distributed. These questions should be prepared with Scrum, referring to the different types of waste reduction in the lean section, Visual Management and Hourensou. After the questions are answered the information so that a concrete solution can be announced.

For the third problem, Six Sigma is used, since it is a defined framework, as explained before. This part will overview previous sections. Since this was a process improvement project, the DMAIC approach was used. Each part of the DMAIC cycle is explained below.

#### Defining

This phase should contain the *business case*, which explains why the issue impacts the organization. Next, identify the *problem statement*; this is a short description of the problem. Next, the *goal* should be stated.

The scope of the project should be clear from the beginning. Expectation management is an important part of any project. It is important to clarify what is in the scope, and what is not part of the team's job. For this specific exercise the team decided the In/Out Frame. This is a visual tool with a rectangle; inside of which are the required tasks. The external part will have the unimportant tasks. The figure 17 shows a graphical explanation of this technique.

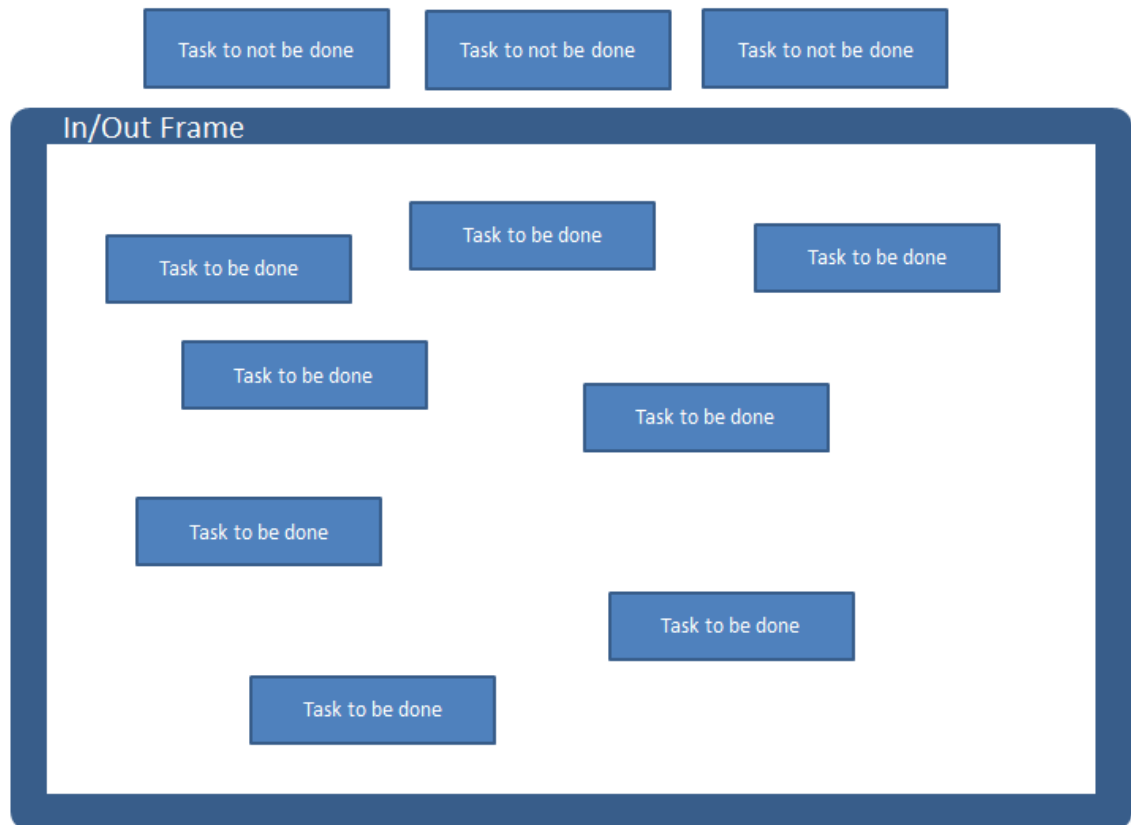


Figure 17. Scope In/Out Frame.

The next step is identifying team members in order to build a Gant chart describing the task's timeline. In order to manage the project, a Stakeholder analysis is performed. The next step is to build the Voice of the Customer table. There are four important parameters to a VOC table. "Who" refers to the relevant customers; second "What and why": is what the team wants out of the improvement. The third one is the "Verified by which source". After defining desired improvements, the team must produce information about the improvement. The last one is the CTQ-Metric, this is the place where the team says what the acceptance criterion for the project is. For example, the future pass rate needs to be 98% or above. From the Voice of the Customer table, it is

possible to build the high-level process map with the SIPOC table, and the columns from the previous section.

### Measure

The objective of the Measure phase is to identify the largest problems. First, a data collection plan for the input and output metrics should be established. A CTQ tree can help the team identify questions. This tool helps identify inputs and outputs.

It is important to define what will be measured, how to measure it, what kind of sample strategy will be used, and whether data is continuous or discrete. To make sure that everyone uses the same metrics and terminology, a terminology table should be created. After this an explanation of each measure is required. To generate all the graphics, the team used a tool called SigmaXL. This tool generates different types of graphics to help the team understand the process. The Measure phase is over with the Cost of Poor Quality. This is where the team verifies how much they are overspending.

### Analysing

Analyse phase is the phase where the team examines the data and process problems. There are two parts that must be considered: data analysis and process analysis. First the team needs to explore the data available and generate hypotheses; these hypotheses will be taken to the next level, where the team will use proper tools to explore possible solutions. Some of these tools are Cause and Effect diagrams, flow charts, etc. All these tools were explained in the Six Sigma part previously in this section. Section number four presents proper use of these tools in practical terms.

### Improving

The main objective of this phase is to find, test and explore possible solutions. At this point the team should know what the root problems are and take measures to eliminate them. In an optimal scenario the team should do a cost benefit analysis to see what the relationship between solution implement and benefits are. During this phase the team will begin the new process in a small scale project. Ideally, the pilot project would be a successful, allowing the team to escalate the improvements to a production environment.

## Controlling

As stated previously, this is the last part of the DMAIC methodology. The objective of this phase is guaranteeing a long term process control. This can be seen as the standardization phase explained on the Lean manufacturing section. Actions like documenting improvement, establishing ongoing process measures, and building a process management plan are taken in this part. This part closes the Six Sigma part.

As a review of this framework, a graphical representation is available in Figure 18.

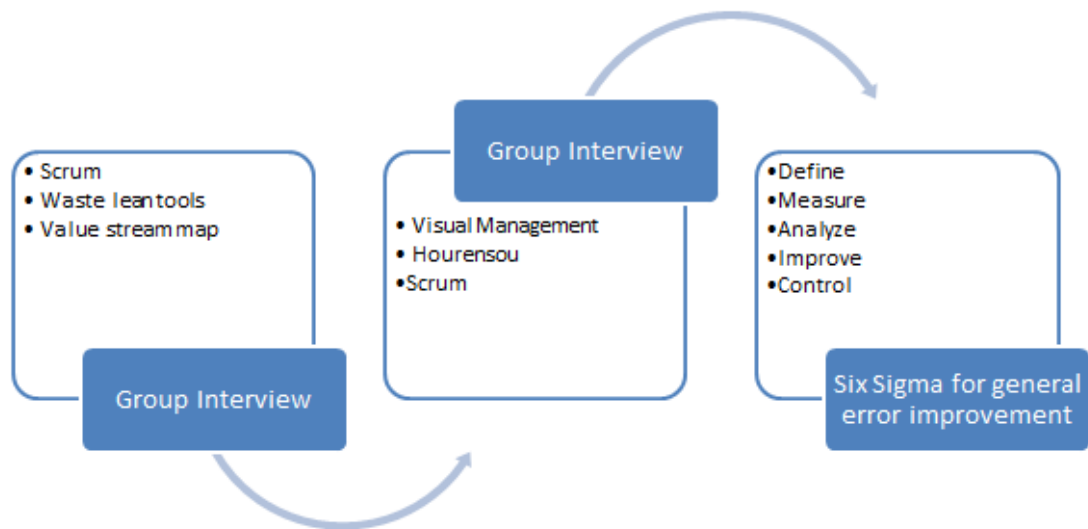


Figure 18. Framework for Process Improvement for Software Localization.

Having the PDCA cycle in mind, the team decides this approach contributes to continuous improvement inside of the team. But having the PDCA approach together with Six Sigma would take too much effort and probably overlap, so the team decided to have a less formal approach. They used the release retrospective to identify the biggest issues of the release, and use the framework to study underlying causes. A graphical explanation can be observed in Figure 19.



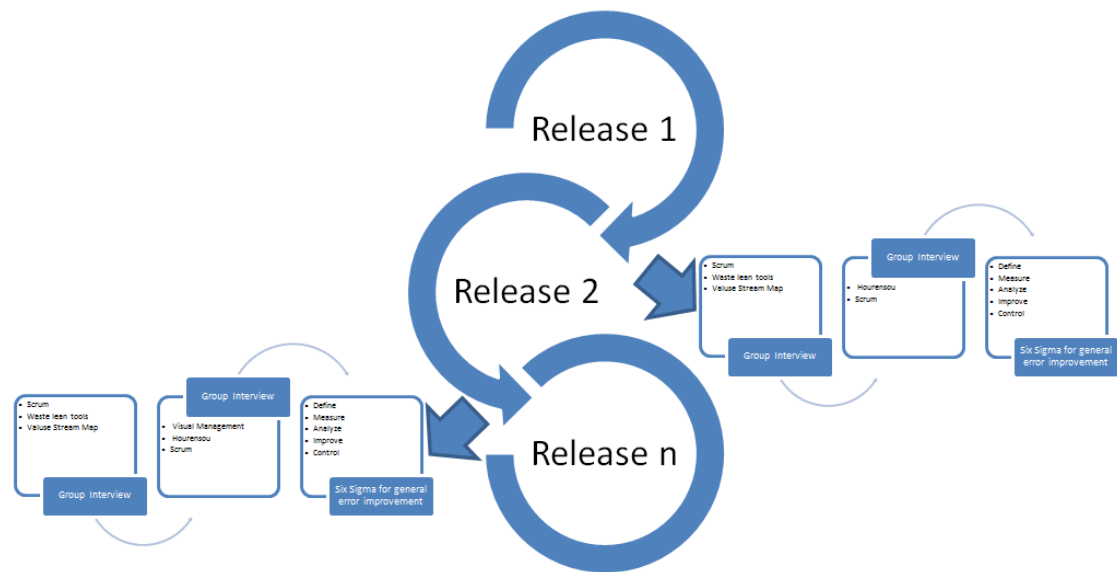


Figure 19. Future implementation of the framework together with the releases.

The next section showed how this theoretical part can be applied in a real project. The localization team did apply this framework to the localization process.

## 4 Development of an Improved Process for Software Localization

In this section, the new framework is presented, which was developed based on the literature analysis in the previous section (Section 3) and based on the answers collected with the group interview. This framework became one of the three parts of the overall improvement process. The overall improvement was divided into the following three steps:

First, improving synchronization between two teams (the software development and localization teams), which were previously working with different cycles (three and five weeks accordingly). This was the first big challenge to address, using the Scrum cycle. To come up with a solution, the team decided to use several brainstorming sessions, and also consulted other units in the company to see if they had similar problems.

Second, the team faced a lack of communication. To solve this problem, the team used the Visual Management and Hourensou tools. Since the team will always need to work with the engineering team, they must both add Scrum to their package. With all tools and methodologies in place, the team organized a brainstorming session to come up with a solution to the communication problem.

The third step was identifying problems with the overall localization process; mainly related to the quality of translations. To identify the overall process, the team decided to apply the Six Sigma framework (as it was presented Section 3). This phase was the third and final suggested process improvement.

These steps are described in more detail in the following subsections (4.1, 4.2 and 4.3).

### 4.1 Synchronization of Team Work in Localization Process

Starting with the first part of the improvement process, the results of the group questionnaire (Appendix 2) clearly show that both teams cannot reduce the localization process time in less than five weeks because the team is waiting for a stable build from the engineering team, even if the team could test the localization after the first week. The results can be observed in questions one, four and five. Question three shows that the localization process consistently took more time due to problems with the build, or lack of testing devices. This clearly shows that an optimal solution would eliminate testing and waiting period. Based on question six, the team should aim for a solution

where the localizers would not need to wait for a stable build in order to test the localized software. "A prototype tool" should be located in order to test the localized software,. To attract additional expertise, several other localization teams inside the company were contacted to learn if they had any solutions. After collecting their feedback, the local team found out that the company had relevant tools. The User Interface team, when designing the specifications, uses a design tool that actually supports the use of translations. It turned out that, using an emulator, with the design made by the User Interface team, it is possible to test the localized software without waiting for two weeks. In the third week for the team could fix the bug. This would take requirements found with the second question and last question into consideration. A graphical representation of the suggested three-week process is shown in Figure 20.

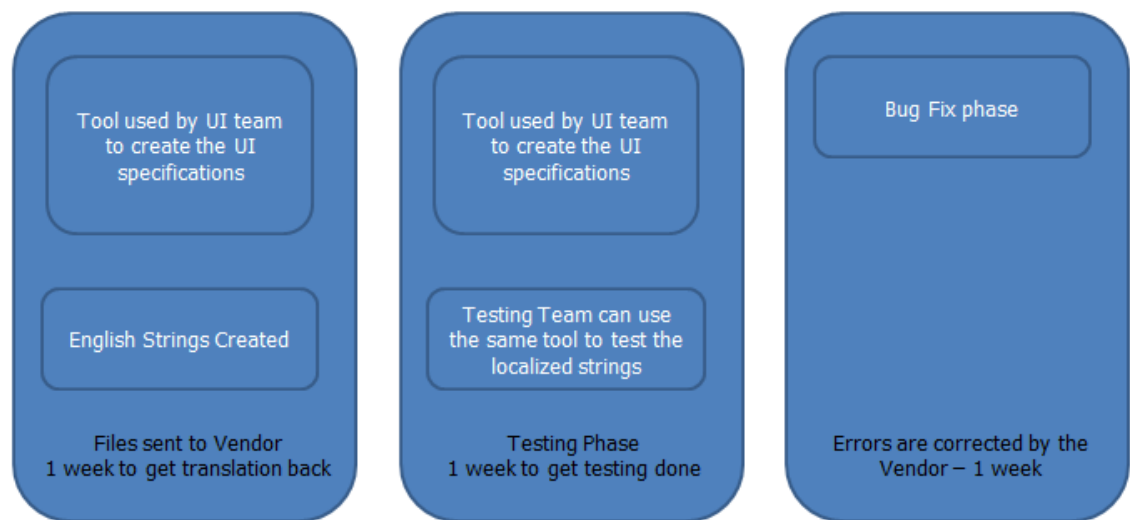


Figure 20. Three weeks Cycle for Localization process – New Process.

The next part will concentrate on solving communication issues.

#### 4.2 Development of Communication Between Teams

Lack of effective communication between teams is another big issue the (question seven and eleven). To solve this problem, to the team approached it with three different tactics.

First, the team needed to improve communication, within its own team, and with other teams. To solve this issue, the team combined two methods described in the Lean section: "Hourensou" and "Visual Management". Hourensou is a method to promote and

facilitate communication, while Visual Management is used to make everything more visible and clear. These two methods, if combined, could be used to tackle the communication problem inside and outside of the team, address information sharing, and increase awareness about localization in other teams (questions nine, ten and eleven). To combine these two methods, the team created a big board on the wall where the team would keep track of daily activities and important information such as testing results, process description, and other issues. Figure 21 presents its graphic design.

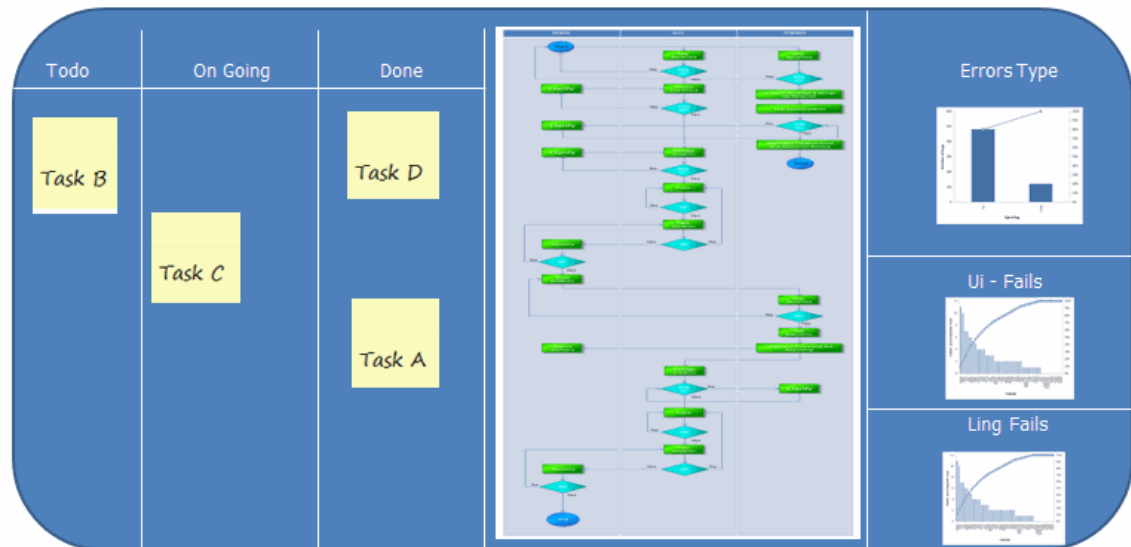


Figure 21. Board with information (comb. Hourensou and Visual Management methods).

Second, the team negotiated with the engineering team, and requested that the local localization manager be present at the daily stand-up meetings, to be aware of the changes made by the development team. The same will happen with the internal localization team. They will have daily stand up meetings, resuming what they did on the day before and what they will do during that day. This should solve the problem raised in question eight. Third, another important achievement is that the localization team was able to request only ready and necessary strings from the development team. This will reduce costs and efforts.

Questions fourteen, fifteen and sixteen clearly showed that the team knew about problems in the process, but was not sure what they were. The team used the Six Sigma tool for process improvement. This framework is used when teams cannot identify root causes. The use of this framework is described below.

### 4.3 Identification and Corrections of the problems of the Overall Localization Process

To identify and make improvements to other parts of the localization process, the team decided to use Sigma Six frameworks. This part was divided into two sub-sections. Six Sigma was first used in the Defining, Measuring and Analysing section, second the Correction part, and third the Improving phase. This section was written such that anyone with a basic understanding of Six Sigma can follow and apply the instructions to their own project.

#### 4.3.1 Identification

Below are the steps required to identify problems in the process, starting with the Defining phase.

##### Defining

For the case company localization team this project was quite important, since ***one fifth of the annual budget was spent in bug fixing***. From a business point of view, there was a really good opportunity for an improvement study. When this study was made the pass rate was between 80-90%. These figures were worse before, but the team was able to improve these numbers with small kaizan initiatives (Small quick wins activities). ***"Pass rate for localization is around 90%, which results in internal dissatisfaction and increased costs"*** this was the problem statement defined for this study. This study aims to ***Increase the localization pass rate to 98%***; as such the CTQ(Critical to Quality) statement was defined as follows: *Localization pass rate needs to be 98% or above.*

Having defined the requirements, the next step is to define the scope. This kept members focused, and prevented wasting time on unimportant tasks. Since the goal of this study is to ***"Increase the localization pass rate to 98%"*** the first task was to identify the main problem decrease the Fail Rate. They used *"pass" or "fail"* attributions to understand this from a vendor's point of view.

The team had a long history of reports that could be used to separate the bugs in two different categories, UI fails and linguistic fails; UI fails occur when the string is longer than the space on the device to be displayed, the final result will be a string with three dots at the end. Linguistic fails occur when the final outcome contains a string with a bad translation or with spelling errors.

Since lean and agile are about speedy improvement and delivery, this project would not be complete without increasing the speed of localization.

Finding solutions to functional problems is out of the scope of this Thesis; this being said the In/Out Frame is included below.

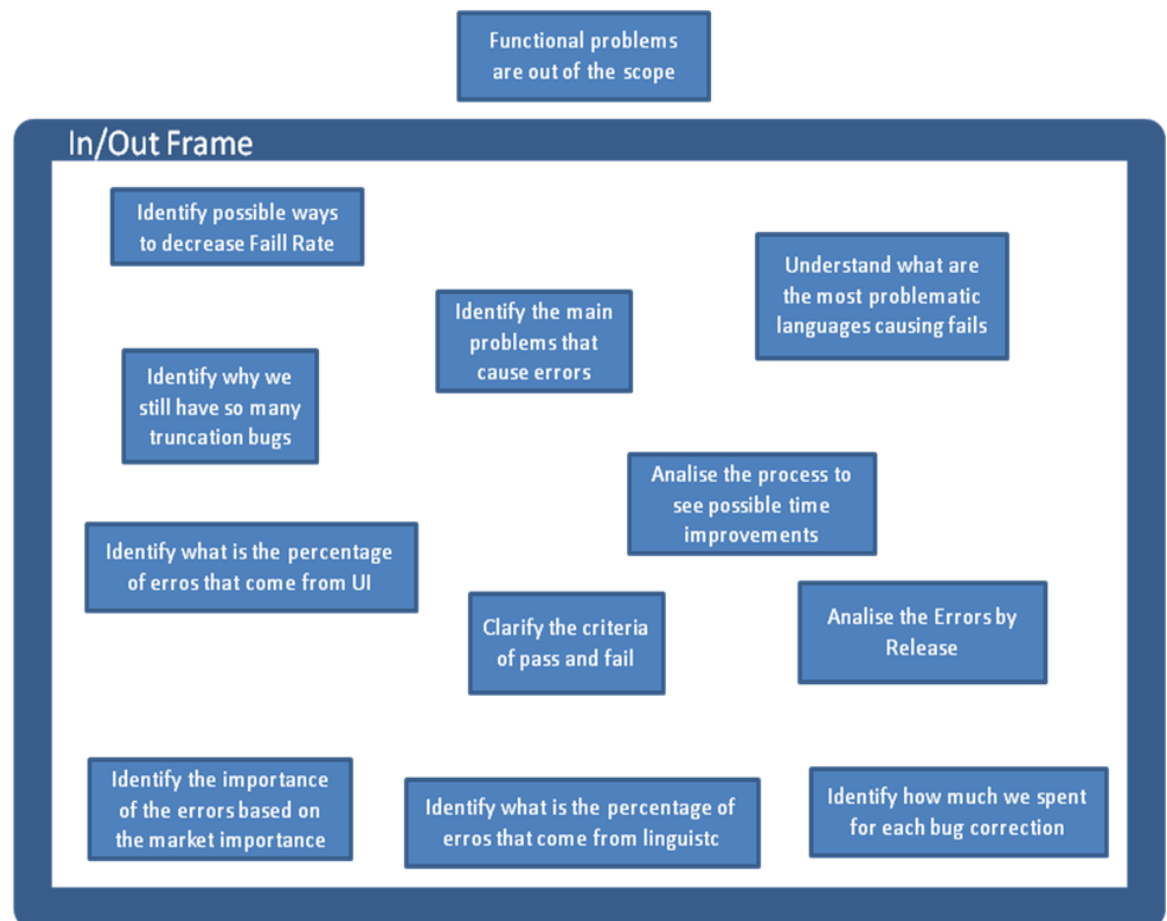


Figure 22. Scope In/Out Frame.

The team and scope are both identified. The Project leader executed this study , his colleagues Ayako Ota and Georgi Sabev worked as project members, and their line

manager was the project champion – Sandra Neto dos Santos. The activities performed by these people could be tracked in a Gant chart.

In order to identify the stakeholders of this project, a simple stakeholder analysis was performed using a simple Power/ Interest matrix, as shown in Figure 23.

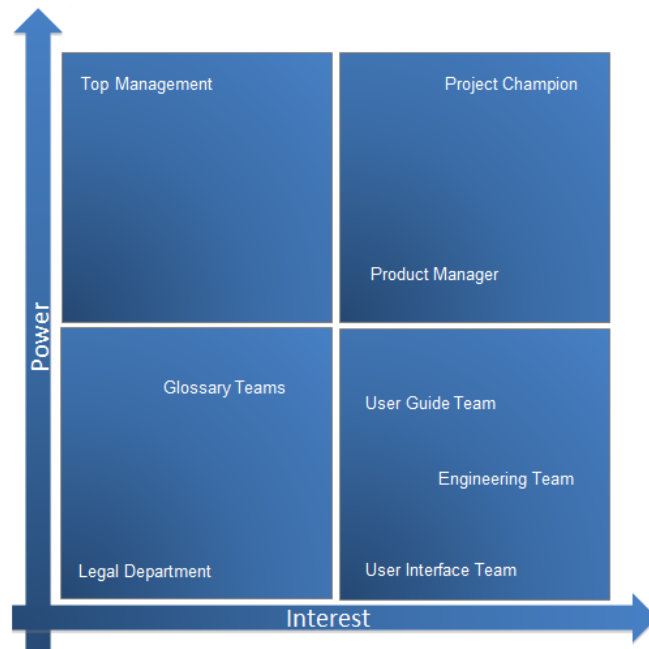


Figure 23. Stakeholder Analysis, Power vs. Interest.

This study allows the team to understand how people are directly or indirectly involved in the project. The team should use this information to make sure the needs of these people are met in order to avoid damage to the normal project.

The localization team works with two vendors, one of them specializes in providing localization services, and the other specializes in testing services. The team needs to interact with several internal teams, not just with external vendors. There are development teams requesting translations; and the legal department, which the team may contact verify legal terms or country names. The marketing team is quite often contacted for feedback, and some translations aren't clear from the internal point of view. The marketing department gives guidance in approaching local markets. This information together with the information from the "Current state analysis" is presented in the SIPOC table in the Table 6.

Table 6. SIPOC Table.

<b>SIPOC</b>				
Suppliers	Inputs	Process	Outputs	Customers
<b>LOC. V.</b>	UI specs	Translation	Trans. Delivery	Internal Teams
<b>Internal teams</b>	Background info	Testing/ verification	Trans. With bug fixing	Global Market
<b>Test V.</b>	Bug Reports	Bug Creation		
<b>Legal Team</b>	Test Reports	Bug Fixing		
<b>Marketing</b>	Lang. Req.			
<b>Terminology Team</b>	File Format			
	File Naming			

With the information described above it was possible to design the high level process as is described below on the Figure 24.

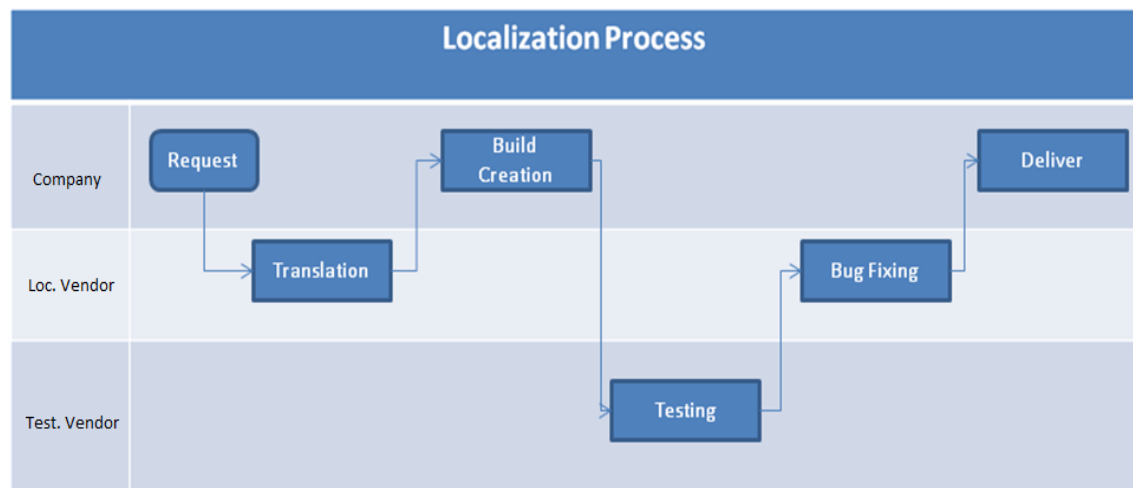


Figure 24. High Level process for localization.

One more task remains. Defining the VOC parameters, as presented in the Table 7.

Table 7. Voice of the Customer Table.

<b>Voice of the Customer Table</b>			
Who	What and Why	Verified by which source	CTQ-Metric
<b>Final Users</b>	Localization Quality	External Survey	Survey results need to



<b>Internal Stakeholders</b>	(Well translated) No UI problems-No truncations Process Improvement	Testing Reports Development Cycle	be >95% on satisfaction  Testing pass rate needs to be >98%  Process will take maximum tree weeks
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### Measuring

In order to perform Data Collection the team was encouraged to find several questions for the ones they wanted to answer; Table 8 shows these questions.

Table 8. Questions to be answered after analysing the data.

Identify the percentage & number of errors that are linguistic errors
Identify the percentage & number of errors that are UI errors
Identify the percentage & number of errors based on different releases
Identify the most problematic languages related with UI and Linguistic

The previous table can be mapped as a CTQ Tree, represented below on the Figure 25.

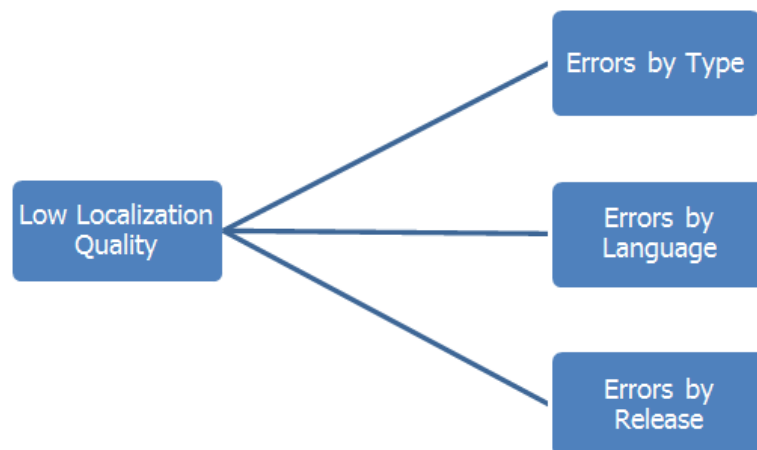


Figure 25. CTQ Tree with questions to be answered after analysing the data.

After the questions are defined, it's important to understand what kind of data is used (discrete/continuous), how that data is measured, where the data is recorded, which

sampling strategy is used and by who. With this information the team will have what is called the "Data Collection Plan". This information can be found in the Table 9.

Table 9. Data Collection Plan for this Project.

<b>Data Collection Plan for Project: Improve Localization testing pass rate</b>					
<b>Goal: Reduce the fail rate until the max of 2% in each testing round</b>					
<b>Measures</b>	Type	How to measure	Where to record it	Sampling Strategy	Who
<b>Number of test cases that failed</b>	Discrete	Test report delivery	Test report delivery	All releases from 2010	Localization Manager
<b>Percentage of test cases that failed</b>	Continuous	Test report delivery	Test report delivery	All releases from 2010	Localization Manager

Before continuing it's important to clarify some concepts: "Defect", "Unit" and "Defect Opportunities" (again choose either quotation marks or italics for key terms); A defect is any condition that does not meet the specifications of a CTQ, in our project the 98% pass rate is considered a defect. The unit can be defined as an item produced or processed. This Thesis defines a unit as a "Test Case". And for the last number, Defect Opportunities can be defined as any measurable event that provides a chance of not meeting a CTQ, in our project 1 (Its either below 98% or over 98%).

Table 10. Table with the definition of Defect, Unit, #Defect of Opportunities.

<b>Terminology</b>	<b>Definition</b>	<b>Project</b>
<b>Defect</b>	Any condition that does not meet the specification of a CTQ	Pass Rate lower than 98%
<b>Unit</b>	An item produced or processed	Test case
<b>#Defect Opportunities</b>	Any event which can be measured that provides a chance of not meeting a CTQ	1 (its either below 98% or over 98%)

Having defined everything, the team needed to define the measures; this is demonstrated in the tables below.

Below is the number of UI test cases which failed.

Table 11. Measure definition: Number of test cases Failed – UI.

<b>Name of the measure: Number of test cases Failed – UI</b>	
Number of test cases that fail because of UI Problems, for example truncation  The test reports were used to measure these errors.  This errors are just UI related not linguistic	Definition of Measure
	Procedure – how to measure
	What the Measure does not include

Below is the number of linguistic test cases which failed.

Table 12. Measure definition: Number of test cases Failed – Linguistic.

<b>Name of the measure: Number of test cases Failed – Linguistic</b>	
Number of test cases that fail because of Linguistic Problems, for example misspelling  The test reports were used to measure these errors.  This errors are just Linguistic related not UI	Definition of Measure
	Procedure – how to measure
	What the Measure does not include

Below is the percentage of UI test cases which failed.

Table 13. Measure definition: Percentage of test cases Failed – UI.

<b>Name of the measure: Percentage of test cases failed – UI</b>	
Number of test cases that fail because of UI Problems, for example truncation  The test reports were used to measure these errors.  This errors are just UI related not linguistic	Definition of Measure
	Procedure – how to measure
	What the Measure does not include

Below is percentage of linguistic test cases which failed.

Table 14. Measure definition: Percentage of test cases Failed – Linguistic.

<b>Name of the measure: Percentage of test cases failed – Linguistic</b>	
Number of test cases that fail because of Linguistic Problems, for example misspelling  The test reports were used to measure these errors.  This errors are just Linguistic related not UI	Definition of Measure
	Procedure – how to measure
	What the Measure does not include

The final task before data collection was stratifying the questions would be stratified in order to obtain the right information. A CTQ Tree was used once again in this exercise.

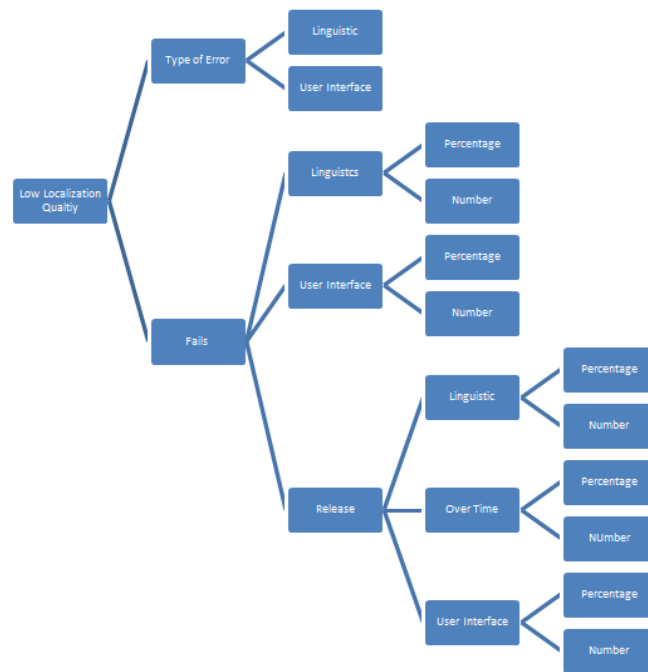


Figure 26. Questions stratification.

The Appendix 1 shows all the graphics generated using the SigmaXL tool. These graphics shows of the amount of errors per language, the ratio between UI errors and linguistic errors, the number of errors per release and the relationship between the number of test cases and errors.

With these graphics, it was possible to identify 80% of the bugs with UI issues, only 20% of the bugs relate to linguistic problems. On the linguistic side, Greek, Urdu, Latin America Spanish, Catalan, Icelandic and Galician together are responsible for 40% of the total linguistic errors. Additionally, the pass rate does not have anything to do with time; this means that there was no relationship between results and the time frame. There was also no relationship between the fail rate and the amount of test cases. Sometimes with smaller test cases the pass rate is lower. The team than ran a large amount of test cases.

The cost of poor quality was the last part analysed in the measure phase. Since the local team worked with external vendors, it was easy to open the invoices and analyse how much was spent wastefully. As mentioned in the current state analysis, the com-

pany was spending around 150 000€ per year in error correction. It is important to improve the quality of the process, because all these costs are found before the product reaches the customer – ***Internal Failure Costs***. It is possible that many other errors are found by the customer, causing a higher consumer cost – ***External Failure Cost***.

The next phase is the Analysis phase.

### Analyse

The team analysed the initial process, which took five weeks. One of the objectives of this study is to reduce the full process to three weeks. This objective was accomplished with the previously suggested solution. Even with this issue resolved the team performed a study to see what else could be improved. The overall process can be seen in Figure 27.

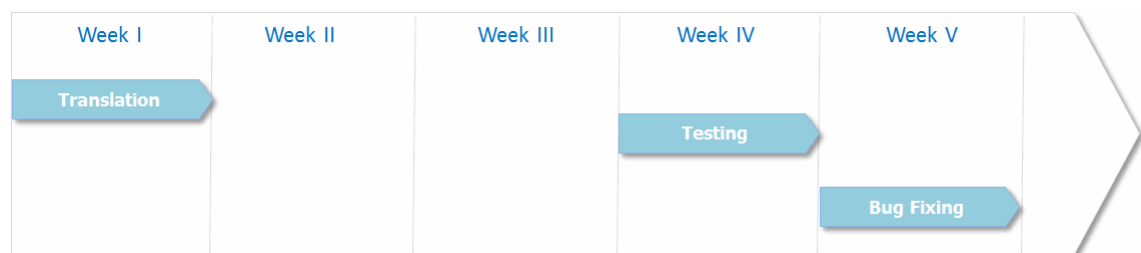


Figure 27. Current Process for Process Localization.

The detailed process can be seen in Figure 28.

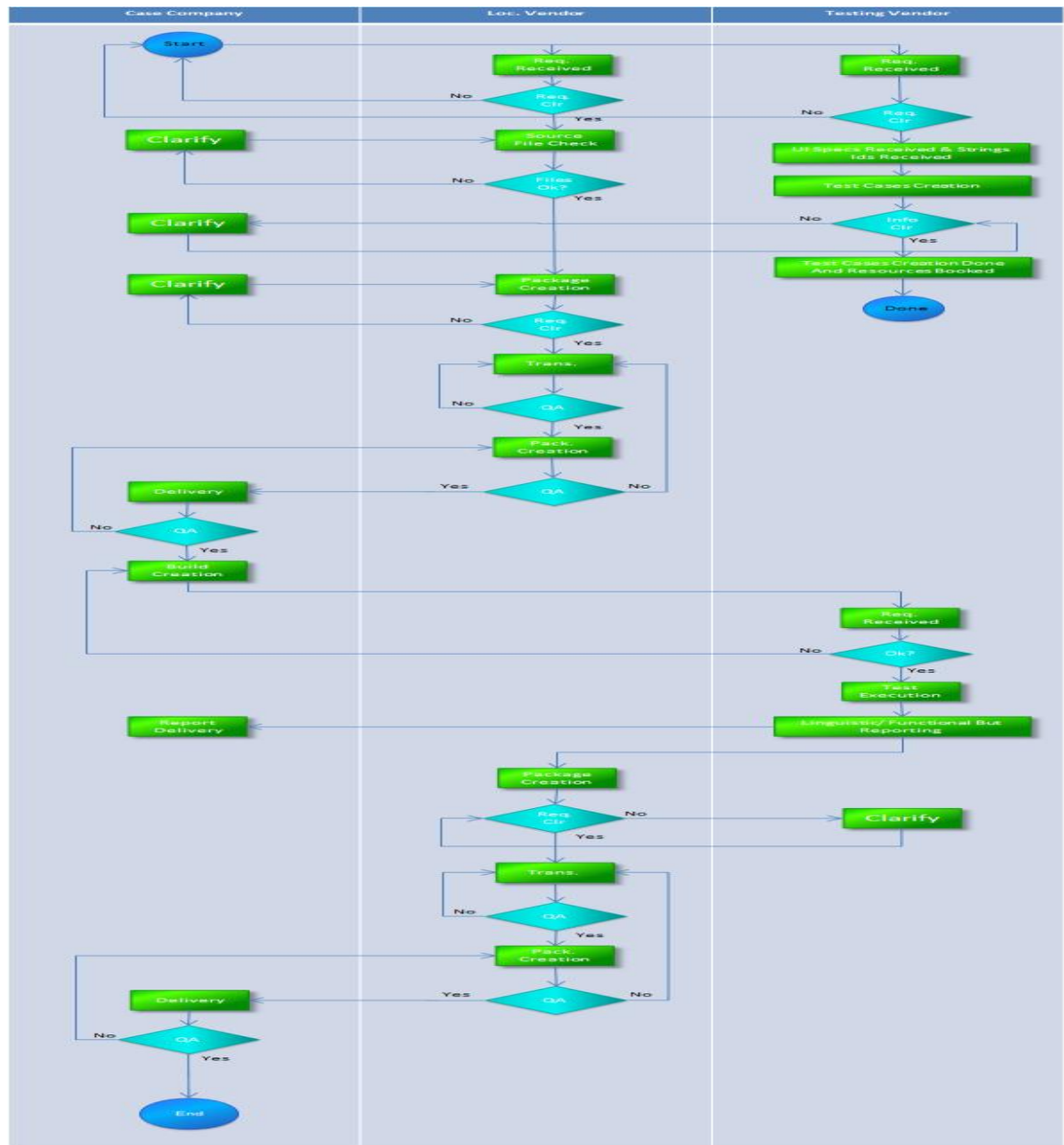


Figure 28. Detailed Process as It Is.

Based on this process, a cycle time analysis was performed in order to understand it's efficiency. The detailed analysis can be found below in Table 15.

Table 15. Cycle Time Analysis after Improvement.

Cycle Time Analysis					
Process Step	VA-PT	VE-PT	NVA-PT	Wait Time	Notes
LOC. V. and Test V. Receives the request	5 m.			0,25 d.	
Clarification req. sent to Case company (LOC. V. and Test V.)	.		1 h.	0,25 d.	

Verify Files Source			1 h.		
Clarification req. sent to Case company			30 m.	1 d.	
Package Creation			2 h.		
Clear Requirements for Translators			1 h	1 d.	
Translation done	2 h.			3 d.	
Package Creation			2 h.		
Send Package to Case company		5 m.			
Case company Verify Package and send it back if something is wrong			2 h.	0,5 d.	
Build Creation		2 h.			
Wait until the end of the sprint				10 d.	
Build sent to Test V.		5 m.			
Test V. Verify that everything is ok if not send it back to Case company		2 h.		0.5 d	
Testing is done		4 d.		4 d	
Test Report done			1 d.	1 d	
Package Creation			2 h.		
Clear Requirements for Translators			1 h	1 d.	
Bug Fix			2 h.	2 d.	
Package Creation			2 h.		
Send Package to Case company		5 m.			
Case company Verify Package and send it back if something is wrong			2 h.	0,5 d.	
Build Creation	2 h.				
Process Cycle Time:	245 m.	36000			
Process Efficiency:	0,68%				

The result was an efficiency of 0.68%. This means that 0.68% of the time, the team is contributing to consumer value.

After analysing the graphics from the previous section, the team noticed that the big problems are UI problems. The process looked stable since the fail rate was more or less constant in all the different releases. With this analysis and with the flow chart map, the team had a brainstorming session using the cause and effect diagram. This exercise sought to identify possible root causes for the origin of the waste. These causes can be seen in Figure 29.

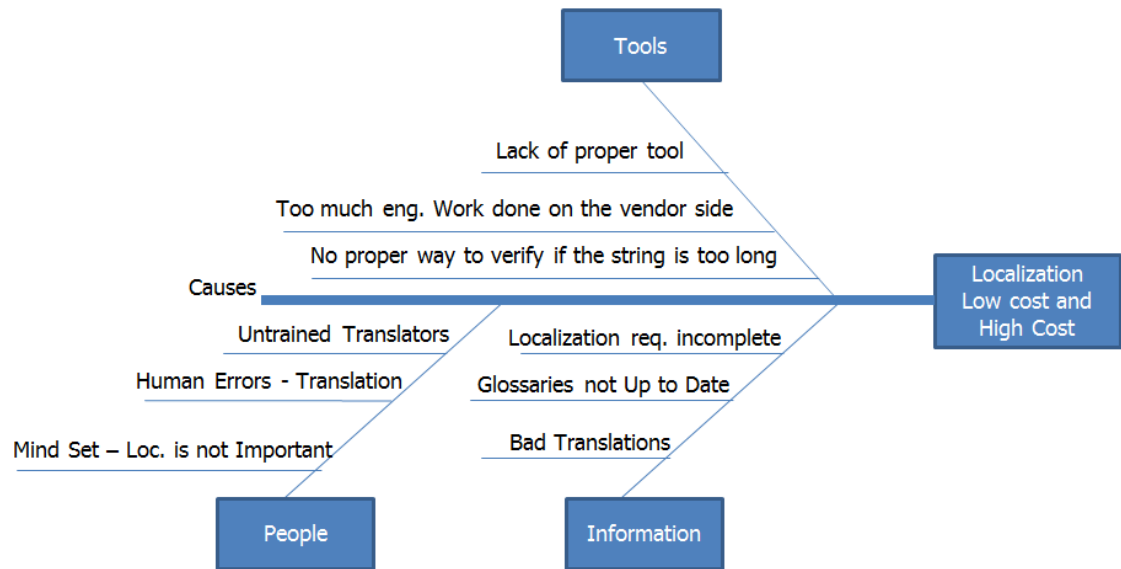


Figure 29. Root causes identified by the team.

Within this section the team was able to identify several problems in the process. A review of the major issues identified is presented below.

The UI truncations present a major issue. They cause four times more bugs than normal linguistic issues. This happens because there is no proper tool for length verification. The translator does not know how much space is available to translate the string; also, only 40% of the linguistic errors are presented in six languages. In the cause and effect diagram, three main areas are identified (tools, people and information). Lack of proper tools caused different problems, such as the one previously mentioned (there is no way to verify the translation length) and too much engineering work on the vendor side. On the people side, as previously stated, there are problems with specific languages. Human errors are evident, it is assumed that localization is purely a translation problem, and this will lead to problems on the Information side. Consumers do not send enough information when they request translation, leading to questions from translators, which create delays, and prevents translators from getting a good understanding about the product, resulting in poor translations. The last problem identified was the lack of current glossaries, causing out dated translations.

Above is a review of the problems identified in the process. The next section will use the Improve phase from the Six Sigma process to present problem-solving techniques.



#### 4.3.2 Corrections

Below are all the steps required for the improving phase.

##### Improving

As previously stated, this phase involves finding, testing and planning solutions. It was previously stated that there are three different problem areas (poor translations, UI truncations/engineer work and quality of translators/QA process).

In order to improve poor translations, the localization team created periodical workshops in different teams to teach about localization, explain the localization team role, and explain what is expected from them and why; this would help them understand that localization is not just translation. Every time they need a localization round, the localization team needs more than plain text to be translated; they need all the relevant background information. The marketing department should become more involved with the localization team, sharing all the marketing material in order to increase understanding of the product among translators. Another solution is distributing phones to each translator, so they use the product and understanding what the product is. As a last initiative the localization team created a share drive for all reference material, in order to share it with the localization vendor. The vendor is responsible for using the shared drive and downloading the latest version; this allows translators to have access to the latest reference material.

The second problem is the UI truncations and overflow of engineering work. There was no proper tool for managing the localization requests. All data was sent with an excel document and the resource files. This caused several problems, such as overburdening the engineering department, and not knowing if translations would transfer to the phones. To solve this problem the team contacted several other teams inside of the company, and tried to find out if they faced the same problems. The local team did not know that the case company had a tool in place that would fix these problems. The next step was to contact the team responsible for the tool and take the right actions in order to gain access to the tool.

The third and last problem had to do with unskilled professionals and poor Quality Assurance processes on the vendor side. The localization team spoke with the localization

vendor in order to reduce the human error factor. The local team negotiated with the vendor, so that all vendor errors would not be paid by the case company, and all expenses would be paid by the vendor, this forces the vendor side to perform better. The localization team agreed that the Greek, Urdu, Latin America Spanish, Catalan, Icelandic and Galician translators would need to be replaced.

The next section presents how the new process will look.

#### 4.4 Future Process

As previously stated, there were three main areas causing problems in localization process; synchronization between the localization team and the engineering team, communication problems between the localization members and engineering team, and problems with overall process.

To solve the synchronization problem in the future, the localization team, together with the user interface team, will use the tool suggested by the team in Vancouver. Using this tool, it will ensure that the localization process lasts three weeks. The testing vendor can use this tool to perform the localization testing instead of using phones. With this new approach, there is no need to wait for stable build from the development team, allowing the process to be reduced by two weeks.

In order to improve communication, a board will be displayed on the team's wall showing all team activities; this board will contain relevant processes and reports. To make sure the localization team was informed of engineering decision, the localization manager began participating in stand-up meetings with the engineering team in order to tackle communication issues.

Finally, to solve the issues with the overall localization problem, the localization team will use the internal translation tool provided by the Tampere team; this tool will reduce engineering work and provide control the length of translation, avoiding UI truncations. These features will result in quality improvement and cost saving. The team will measure the use of a share point space where all necessary material will be posted. The marketing team will be involved in providing several types of product information, to contribute to translators' understanding of the product. The team will send

several devices to the translators, to encourage familiarity with the product, reducing questions during the translation round. The localization team will recommend that ineffective translators should be substituted. Even with experienced translators, human errors occur, therefore the localization team will ask the vendor to review its Quality Assurance process. As a final action, the localization team decided to create several localization workshops with different teams to make people aware of the necessary preparation for localization.

After implementing suggested improvements, the new localization process will take about three weeks to complete, as shown in Figure 30.

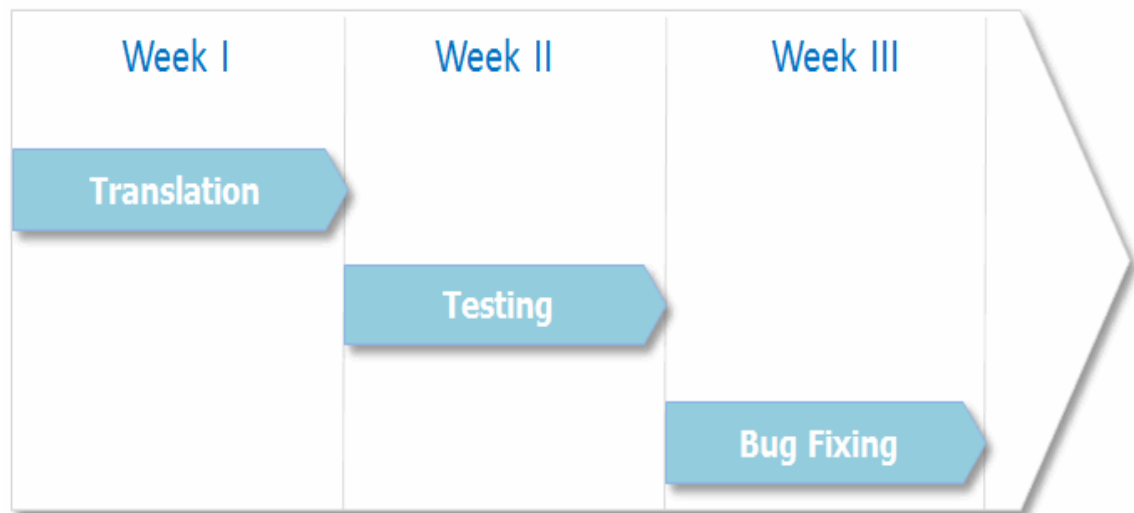


Figure 30. High level of future process.

The new detailed process can be seen below in Figure 31.

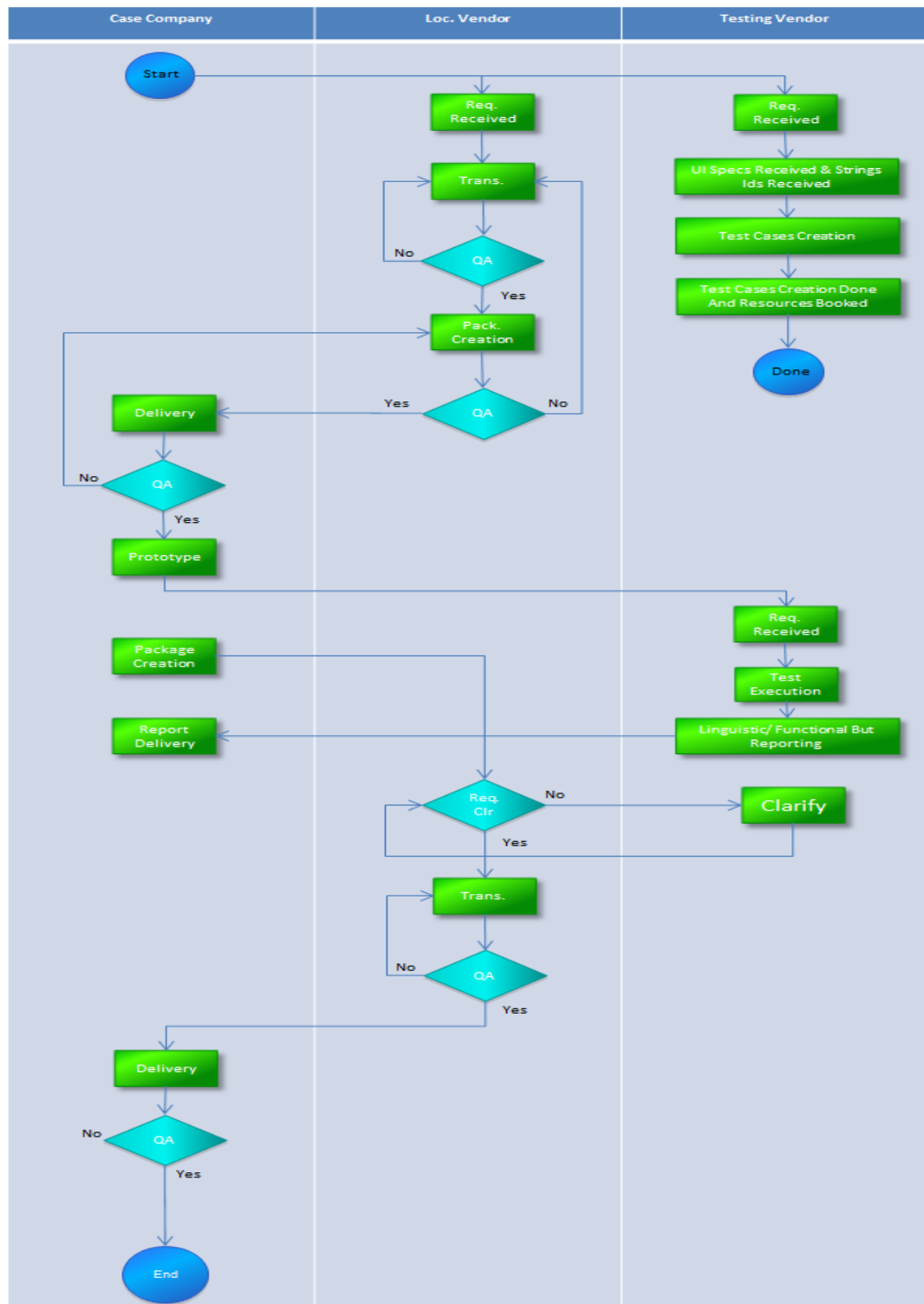


Figure 31. The detailed localization process after the study.

After this activity the team was able to perform a new cycle time analysis. This analysis is visible in Table 16.

Table 16. Cycle Time Analysis after Improvement.

Cycle Time Analysis					
Process Step	VA-PT	VE-PT	NVA-PT	Wait Time	Notes
LOC. V. and Test V. Receives the request	5 m.			0,25 d.	
Translation done	2 h.			3 d.	
Send Package to Case company		5 m.			
Case company Verify Package and send it back if something is wrong			2 h.	0,5 d.	
Prototyping Creation		2 h.			
Prototype sent to Test V.		5 m.			
Testing is done		4 d.		4 d	
Test Report done			1 d.	1 d	
Package Creation			2 h.		
Clear Requirements for Translators			1 h	1 d.	
Bug Fix			2 h.	2 d.	
Send Package to Case company		5 m.			
Case company Verify Package and send it back if something is wrong			2 h.	0,5 d.	
Build Creation	2 h.				
Process Cycle Time:	245 m.	18000			
Process Efficiency:	1,36%				

Described in this section are necessities for answering the research question:

*How can the localization process for software localization be improved, in order to reduce the time to a 3-week period, while keeping the number of errors to a minimum?*

After the construction of the new process improvement framework, the team performed an analysis over the process to identify the key strengths and the key weaknesses. The team identified three weaknesses; first was the need for a final test using real devices. Testing with a simulator helps check if localization was done properly, but this kind of testing does not allow the team to verify if the real software will work correctly. Before the release, a final test using devices is required. Six Sigma is a powerful tool but requires several hours per week of dedication in order to execute this initia-

tive, sometimes it can be difficult to get enough resources to perform this task. The last weakness was the fact that teams would need to interact with several different teams and sometimes change the process. This could be difficult in some organizations. After defining the weaknesses the team identified five strengths. First, is the framework based on multiple brainstorming sessions; this offers innovation and open communication between teams. Six Sigma is a well-known framework for process improvement. Using this methodology is a good way to obtain improvements. The suggested framework does not require any special skills from the team, apart from the Six Sigma part. But even this part requires a team lead who is familiar with the framework. Using this framework at the end of each release would allow the team to identify small problems and take corrective actions without allowing the problems to get bigger in future. The last strength identified by the team was the cooperation and understanding between different teams with the localization team. The other teams can understand how to approach their daily work in order to help the localization team.

## 5 Conclusions and Discussions

### 5.1 Summary

The main goal of this study was to identify a possible framework for process improvement in software localization, and apply it to a new process for software localization. This Thesis was a unique opportunity to perform this kind of study. In most companies, localization is still a part of the software process which is performed at the end of the cycle. This improvement will allow the company to release better software faster, since all localization is performed in small pieces, producing less errors and unneeded effort. The lessons from this study can be shared with other teams inside of the case company, making it possible to save a considerable amount of money and improve the quality of localization. This study was performed in order to understand what could be done to improve the process of software localization. The study described several actions which could be performed in order to improve the localization process. The study revealed methods for improving communication, reducing process and identifying other issues in the localization process. This framework was designed in a way that any localization team can use, to adapt the survey for their own needs. The objective of this Thesis was accomplished.

### 5.2 Managerial Implications

After concluding this study, this framework suggests implementation inside of the local localization team. This suggestion should be easily accepted, since all team members contributed to this study. From the management point of view, this study should be welcomed since its' application results in cost and time saved, and finer products. The managerial implications and the necessary actions are listed below:

- Localization team needs to be part of the development team instead of being an external team
- Creation of a board with the daily activities of the localization team including relevant information like test reports, flow charts, etc.
- UI team must use the UI tool to cut two weeks' time from the process, resulting in a process with a total duration of 3 weeks.
- Use of the internal tool to manage localization

- Marketing team needs to support localization team, and provide marketing materials
- Send a phone to each translator
- The localization vendor must adapt a new Quality Assurance process
- Workshops performed by localization team inside of the company.

### 5.3 Validation

This section presented an evaluation of results versus the objectives at the beginning of this study. The last part of this Thesis is a brief explanation of how the results can be considered valid and reliable.

#### Thesis evaluation

When this study started the practical implementation was out of this Thesis' scope, but the implementation went so well that there was a possibility for a small pilot. With the reception of the first localization testing results, it was clear that most of the problems in the process were corrected. The pass rate is over 98% which is the prerequisite value that the use case company requires to release a product. In Figure 32 it is possible to see the graphical result.

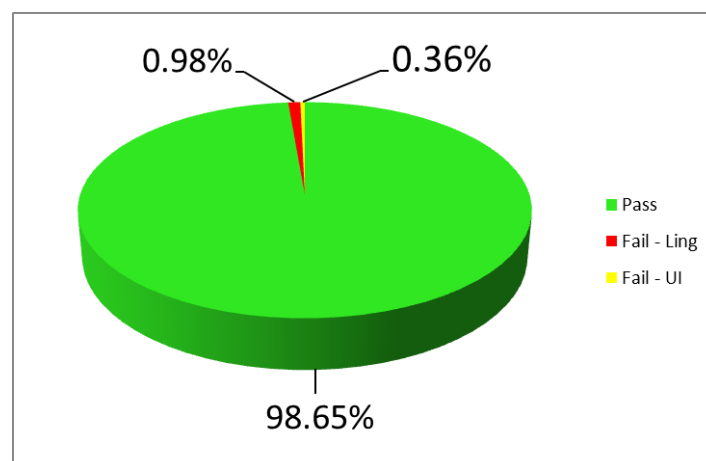


Figure 32. Localization Test Report after piloting.

The overall process gained a small improvement as well. During implementation, the team found a way to overlap testing and bug fixing. The bug fixing could start two



days later than the testing. The testing vendor could report errors at the end of each day and send the errors to the localization vendor, allowing translators to correct all the errors on the next day, allowing the process to be reduced. The final process would take two weeks, and remain one week ahead of the development team. The Figure 33 shows the final high level process chart.

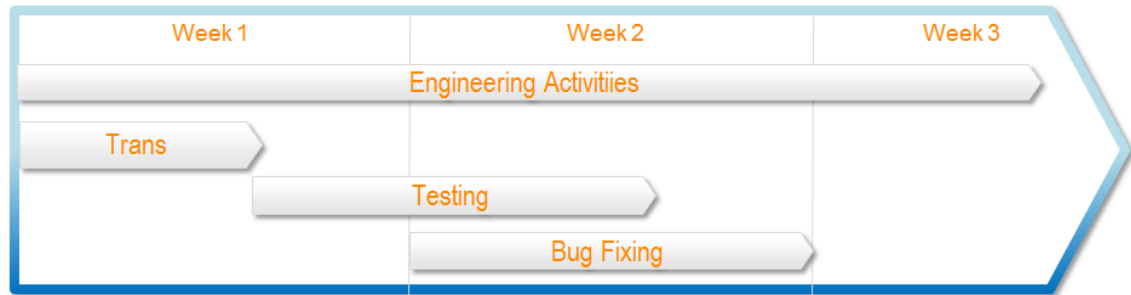


Figure 33. Localization Process after Piloting.

Comparing the final results with the objectives that were proposed at the beginning of this study, it can be stated that the objective of this research was accomplished. When this study started, the total localization process time took five weeks. By the end of this study, the time was reduced to three. The piloting revealed that the final process can actually take only two weeks. This study revealed that addressing issues inside the localization process results in increased quality and reduced spending. The study disclosed that the efficiency of the process can increase two fold.

This Thesis can be used by other professionals in localization field to improve their own localization process. In many companies localization is performed at the very last minute before product release. This can cause delays in the product launch, and more importantly the increases in cost. Sometimes serious problems are discovered that must be corrected before the product to be launched. This Thesis offers the localization community a simple framework to transform the typical Waterfall approach to an agile way of working. All information acquired during this study was shared with several localization teams. Positive feedback from various specialist teams in the case company proved that this study was needed and appreciated.

### 5.3.1 Validity and Reliability

The outcome of this research was a framework for the case company or localization team for future projects. These results of this study are available to the public. Some results, such as the specific UI tool for this case company are not relevant to others. Each company must find their own solution, but they can always use this framework as a general approach to identifying improvements. The research performed for this Thesis was correct. The measurements were accurate, and the results were successful. This study did use an eight person group interview. For future research, it is advised that a wider pool be surveyed. This specific study, proved to be reliable, but it is advised that a larger sample will be used in the future in order to produce reliable research.

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## Appendix 1

Table 17. Number of Errors (UI and Ling) and Fail Rate per Sprint.

Release	Type of bug	Number of bugs	Percentage - Fail Rate
SR5-Sprint I	UI	72	10.94%
SR5-Sprint I	Ling	42	6.38%
SR5-Sprint II	UI	77	26.74%
SR5-Sprint II	Ling	38	13.19%
SR5-Sprint III	UI	1	1.04%
SR5-Sprint III	Ling	2	2.08%
SR5-Sprint IV	UI	11	11.46%
SR5-Sprint IV	Ling	5	5.21%
SR5-Sprint IV - Bat	UI	138	26.14%
SR5-Sprint IV - Bat	Ling	23	4.36%
SR5 - Maturation	UI	19	2.25%
SR5 - Maturation	Ling	1	0.12%
SR6 Sprint I && Sprint II	UI	92	5.99%
SR6 Sprint I && Sprint II	Ling	9	0.59%
SR6 Sprint III	UI	72	9.38%
SR6 Sprint III	Ling	0	0.00%

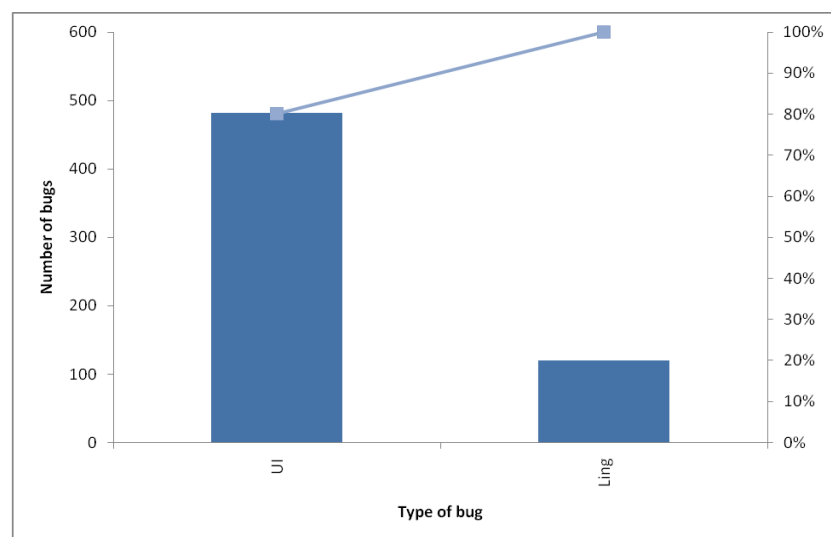


Figure 34. Number of bugs (UI bugs vs. Linguistic bugs).

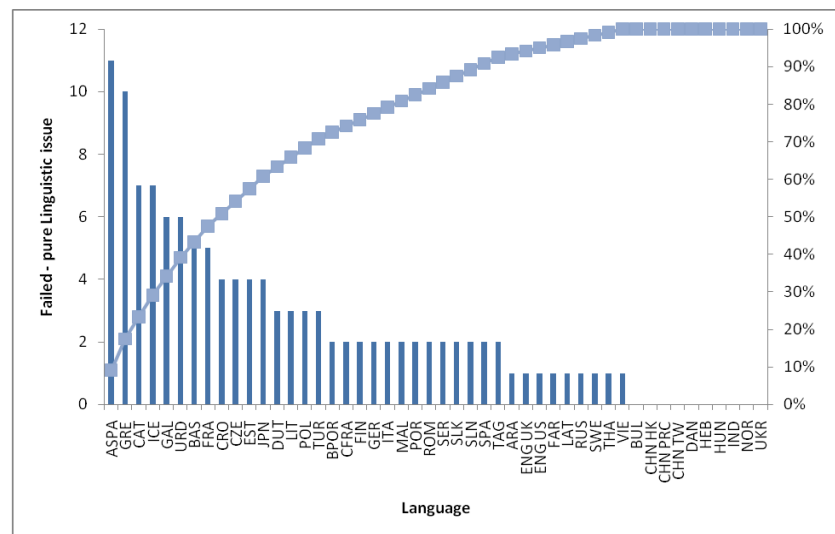


Figure 35. Number of bugs (Linguistic bugs by Language).

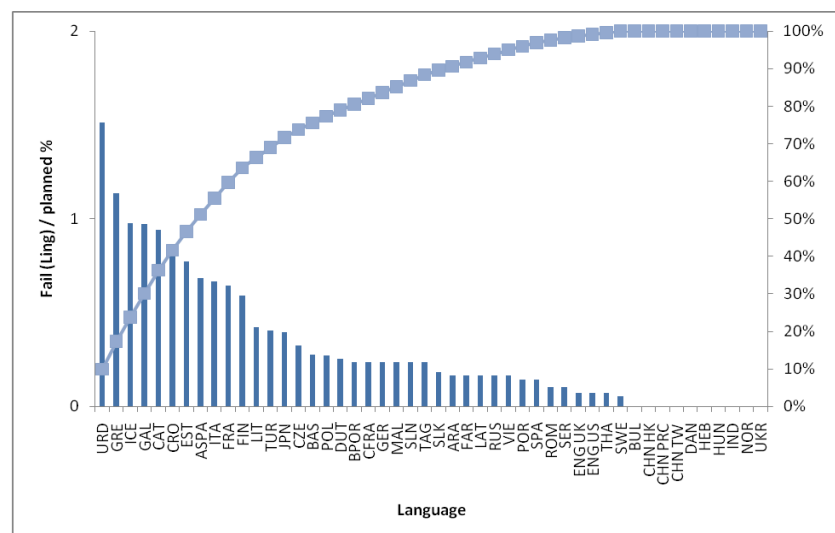


Figure 36. Percentage of bugs (Linguistic bugs by Language).

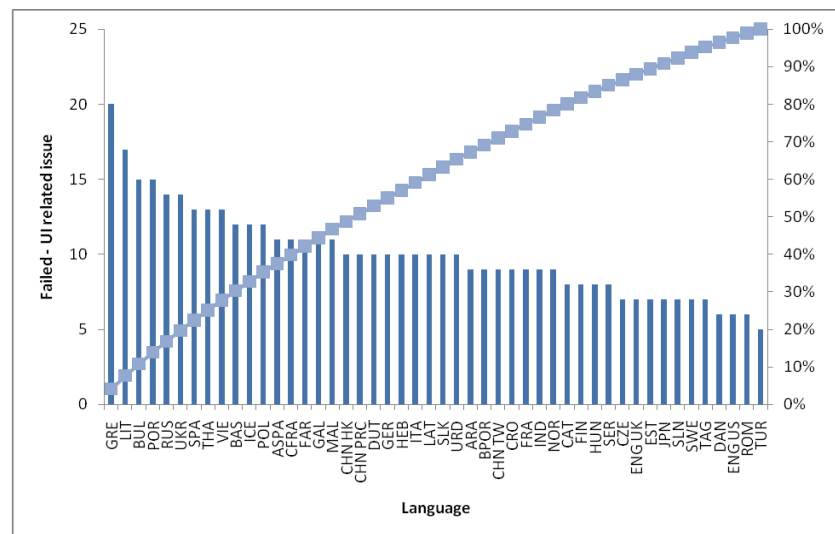


Figure 37. Number of bugs (UI bugs by Language).

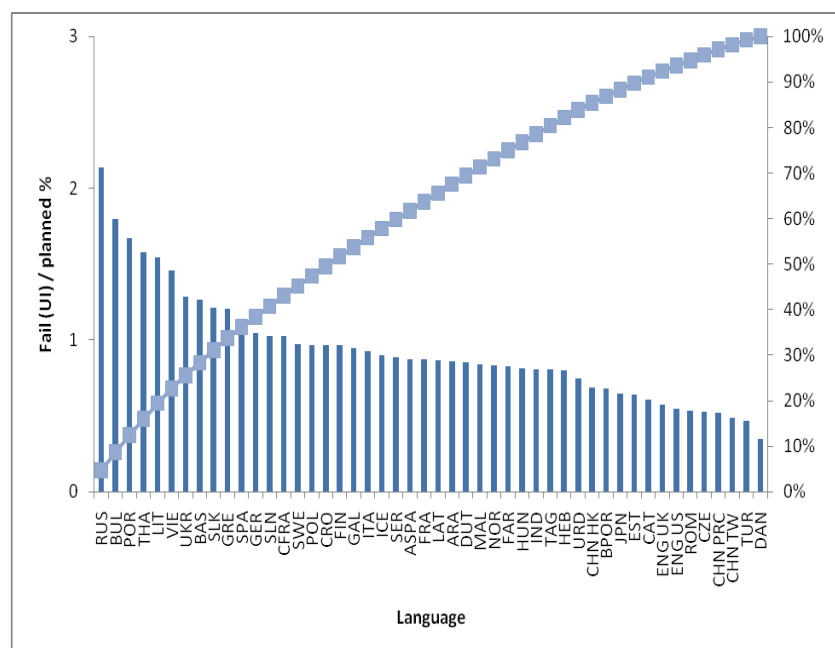


Figure 38. Percentage of bugs (UI bugs by Language).



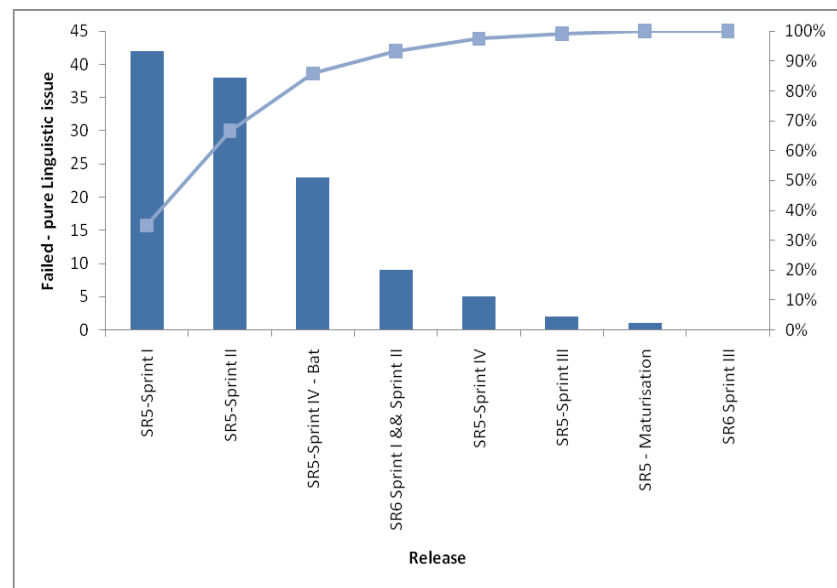


Figure 39. Number of bugs (Linguistic bugs by Release).

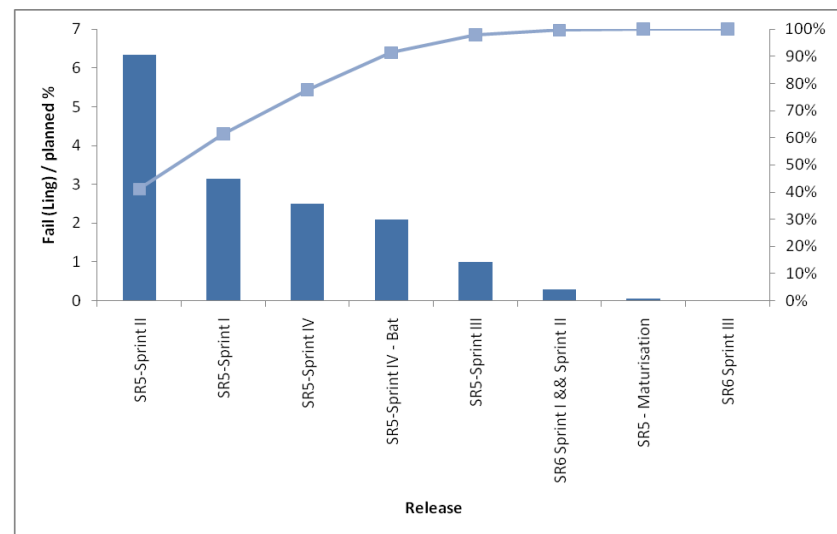


Figure 40. Percentage of bugs (Linguistic bugs by Release).

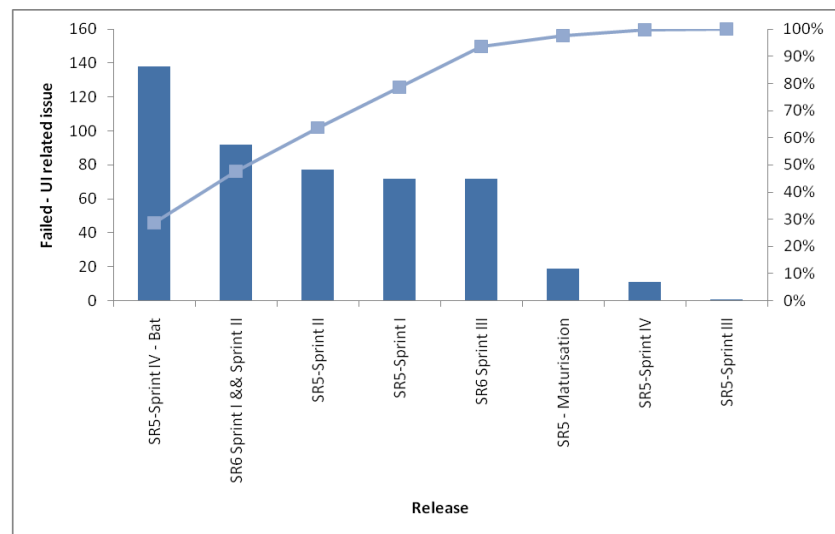


Figure 41. Number of bugs (UI bugs by Release).

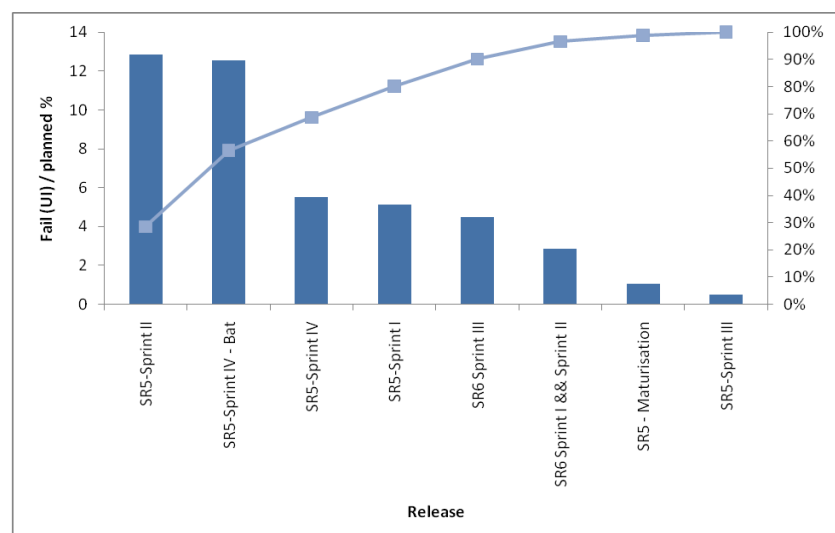


Figure 42. Percentage of bugs (UI bugs by Release).

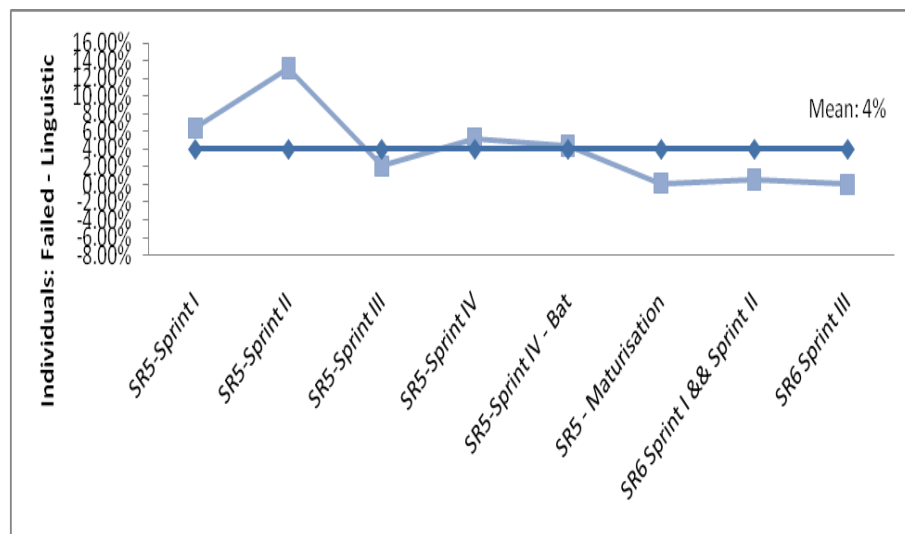


Figure 43. Fail Rate (Linguistic bugs by Release).

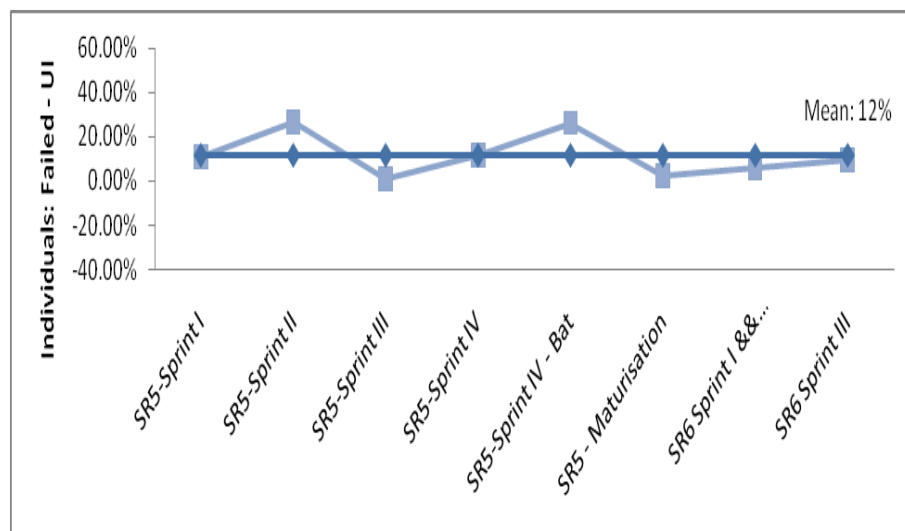


Figure 44. Fail Rate (UI bugs by Release).

## Appendix 2

Table 18. Answers to the groups interviews.

Questions to the Group Interview	Localization Team	Boston Team
1) What is the average time of localization process?	5 weeks	5 weeks
2) What is the maximum time that localization process can take?	3 Weeks – Scrum Sprint	3 Weeks – Scrum Sprint
3) What is the longest time period it took? Why?	7 weeks, Problems with the builds it took a lot of time until provide a proper build	8 weeks – Problems with devices, there were not enough devices to test the application, they were being shared with other teams
4) What was the shortest? Why?	5 Weeks, at this point is not possible to do it because we need to wait for the stable build and that takes 3 weeks.	5 weeks, limitation because of build issues.
5) What is the minimum time to have something ready to be tested?	1 week, after the localization phase	As soon we have the localization done – 1 week
6) Based on your experience what could be done to reduce the time problem?	Find a way to eliminate the waiting time. Most probably there are tool available for that.	Trying to introduce some automation.
7) Communication is a big issue, with whom there is communication problem?	Usually with the engineering team	Engineering team and UI team
8) Do you think that having meetings more often would help?	At least would help	Yes completely agree.
9) How do you think that other teams know about localization process and ways of working?	Very little.	They do not understand what we do.
10) How could awareness of localization be increased?	More information sharing	Having a way to inform them but not using email or Wikipedia, these tools tend to not get the right effect for this
11) How is the communication working inside the team?	Could be improved	Poorly
12) Based on you experience what could be done to improve the communication problem?	Some kind of reports and maybe if we were more together with each other's	More meetings
13) Do you have any idea what is causing so many errors in overall localization process?	No we just know that something is wrong with the process	Maybe lack of knowledge of the translators but I cannot point something concrete
14) Do you know in which part of the process are there more errors?	Not really	No.
15) Which part of the process could be easier to improve?	We would say that trying to reduce the time problem could be the easiest	Waiting time we need to get a way to solve the problem there.
16) Which part of the process could be more difficult to improve?	Everything which on the vendor side	The tasks that don't happen inside of the company
17) What are the requirements for new solution? (Financial, Not much change of common work, etc.)?	It cannot cost money, we do not have budget for that, it cannot change much the normal process of localization and optimal make the process take max 3 weeks	The process would need to take 3 weeks and cannot have any financial impact.